

MAXWELL RENDER

THE LIGHT SIMULATOR
MAXWELL RENDER 1.6
USER MANUAL



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ABOUT THIS MANUAL

The manual should be used as a reference guide. Additional tutorials and further tips will be available elsewhere

NOTE: Plugins specific information can be found with the installation package of each plugin. However, the parameters and features described in MXST chapter can be used as reference for plugin parameters as well.

The manual is divided into five major parts:

General info about Maxwell Render™.
Maxwell Render™ material system.
MXST: Maxwell Render™ Studio, a complete environment to import geometry, create/edit materials and then send the full scene for rendering to MXCL.
MXCL: The Rendering Application.
Network Rendering.

The following icons will appear on some pages to indicate an important point, or a tip:

This icon will tell you if there is something important to keep in mind to avoid common errors, unnecessarily long render times etc.

This icon will indicate useful additional information.

This icon will indicate an enhancement, new feature or function in Maxwell Render™ 1.6 (N)



This manual has been set in Futura BT and Arial regular and bold type faces.
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MAXWELL SOFTWARE PACKAGE

Maxwell Render™ includes three different applications: the render engine (MXCL.EXE), the standalone graphical application “Maxwell Studio” (MXST.EXE) and the standalone material editor with browser (MXED.EXE) for the plug-ins. The software distribution also provides a set of plug-ins for the supported 3D/CAD applications (available on the download page). There is specific documentation included for every 3D plug-in available. The plug-ins take care of collecting the scene information, applying Maxwell materials to objects and sending the full scene to Maxwell for rendering.

INSTALLATION AND LICENSING

INSTALLATION:

Windows:

Run the installation file (maxwell.exe) and follow the installation procedure. The Maxwell executable files will be added to the system path. A user environment variable named MAXWELL_ROOT pointing to the installation folder will be added. If this variable doesn’t exist or is not created properly, the application will fail.

Mac OS X:

Unstuff the installation package and drag & drop the contents into the Applications folder.

Linux:

Installing tar.gz. Copy maxwell64-1.6.Linux64.tar.gz to /opt and uncompress and untar the package. Type both gzip -d maxwell64-1.6.Linux64.tar.gz and tar xvf maxwell64-1.6.Linux64.tar

Create a user environment variable named MAXWELL_ROOT that points to the Maxwell installation folder. Depending on your shell, the procedure may differ slightly. For example, in Bash shell use:

```
export MAXWELL_ROOT=”/opt/maxwell64”
export PATH=”/opt/maxwell64/:$PATH”
```

In csh shell:

```
setenv MAXWELL_ROOT ”/opt/maxwell64”
setenv PATH ”/opt/maxwell64:$PATH”
```





LICENSING:

In order to license copy and paste the license information placed at the end of the license email into the license.txt file located in the Maxwell installation folder. If you purchased your license before Maxwell Render 1.6's release, please note that your license file will also be recognized by Maxwell Render 1.6 and you will not need a new license. If you buy new licenses or need to renew your license, please make sure that you use the license.txt and remove older license.dat files. If you are reinstalling Maxwell Render™ with the old license.dat file, please license the software by adding the "license.dat" file sent by Next Limit to Maxwell using the menu option "Help > Register". Alternatively you can copy the "license.dat" file into the Maxwell installation folder.

BASIC USAGE

Maxwell Render™ contains three main executable files:

MXCL (Maxwell Render™)

This is the standalone render engine. It can read and render MXS (Maxwell Scene) files.

MXST (Maxwell Studio)

A complete GUI application to create and render Maxwell scenes.

MXED (Maxwell Material Editor)

Standalone Material Editor with Material Browser for plug-ins. It is also used for creating material libraries.

Maxwell Render™ provides two alternative workflows. One method allows you to use your existing 3D package and the provided Maxwell plug-in for it to send scene data to MXCL. The other method allows you to import objects into MXST where you create/edit/assign materials, set up lights and cameras and MXST then sends the scene to MXCL.

Below is a description of the basic steps involved in each method:

A) FROM THE 3D APPLICATION USING THE PLUG-INS

The plug-ins allow you to create/edit/apply materials to your object, adjust camera parameters, sky/environment settings, and all other Maxwell relevant options. Initiating a render from your 3D application creates a Maxwell scene file (.mxs) which can either be rendered directly or imported into MXST for further advanced editing. It is recommended to check the documentation of the plug-ins for specific usage. Documentation for each of the plug-ins can be found with the installation package of each plug-in.

MXCL can also be called from the command line by providing a valid .mxs file. The most basic (command line) method to use MXCL is by providing a .mxs scene in the form:

```
mxcl -mxs:scene.mxs
```

A path to the scene can be added:

```
mxcl -mxs:c:\scenes\scene.mxs
```

By doing this, MXCL will start in no-GUI mode, so no render display is available. To be able to visualize the render in progress, you must add the –d option to the command line:

```
mxcl -mxs:scene.mxs -d
```

This will start MXCL and also display its interface where the render in progress is shown and numerous options are available which can be changed during and after the render has finished. Another way to open MXCL with interface is to double click the MXCL shortcut in Windows.

For a description of all MXCL command line options available, please see page 111.

B) FROM MAXWELL STUDIO

MXST is an independent application which allows you to import objects in different formats, apply materials, lights and textures, and render the scene.

This workflow is mostly recommended for people working with 3D applications that do not have an available plug-in to directly connect their scenes to MXCL. But even if there is a plug-in available for your application, MXST can still be used by importing your .mxs scene and making further adjustments or even merging of different scenes using the various tools available in MXST.




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against evolu
"The Father of modern physics"
"From a long view of the history of mankind –
ten thousand years from now – there can be little
most significant event of the 19th century w
Maxwell's discovery of the laws of ele
– Dr. Richard Feynman, Nobel Laureat
"And God said:
$\nabla \cdot D = \rho$
$\nabla \cdot B = 0$
$\nabla \times E = -\frac{\partial B}{\partial t}$
$\nabla \times H = J + \frac{\partial D}{\partial t}$
"Teach us to study the wor
that we may subdue the e
and strengthen our reason
and so to receive Thy bles
we may believe on Him wh
sent to give us the knowled
and the remission of our s

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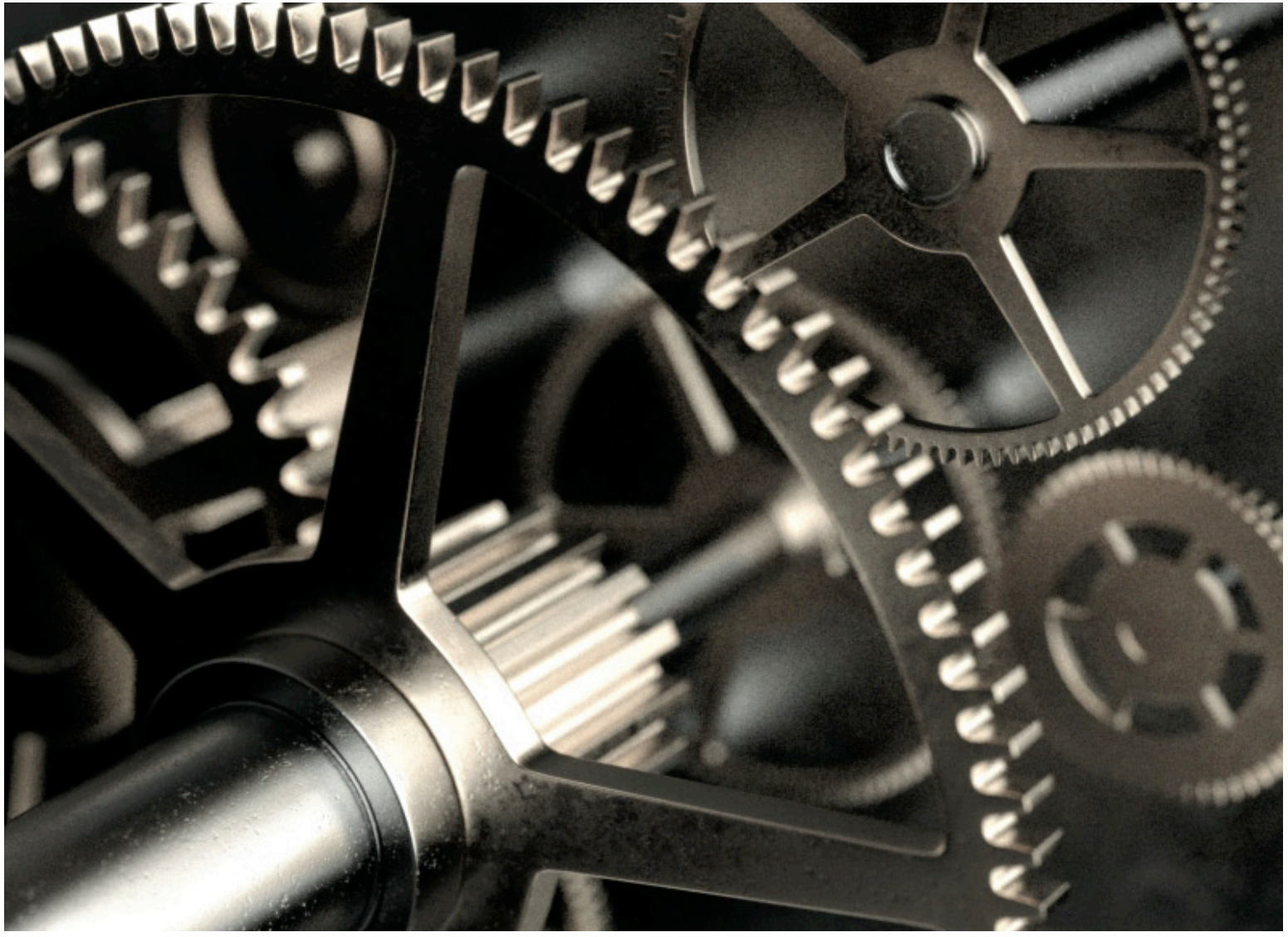
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WHAT IS MAXWELL RENDER™

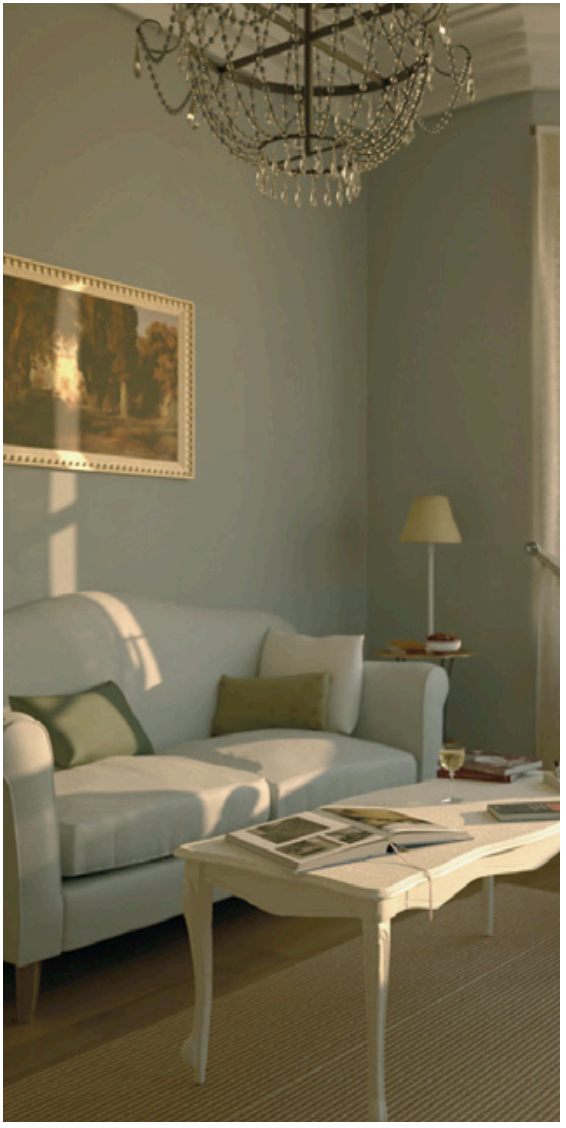
Maxwell Render™ represents the next generation in rendering technology. It is based on the physical equations governing light transport and enables users to digitally create highly accurate and believable imagery of the real world. Maxwell Render™ produces incredibly realistic illumination without resorting to the tricks and approximations used by many current industry standard renderers. Maxwell Render™ is more than just a render engine, it is The Light Simulator.

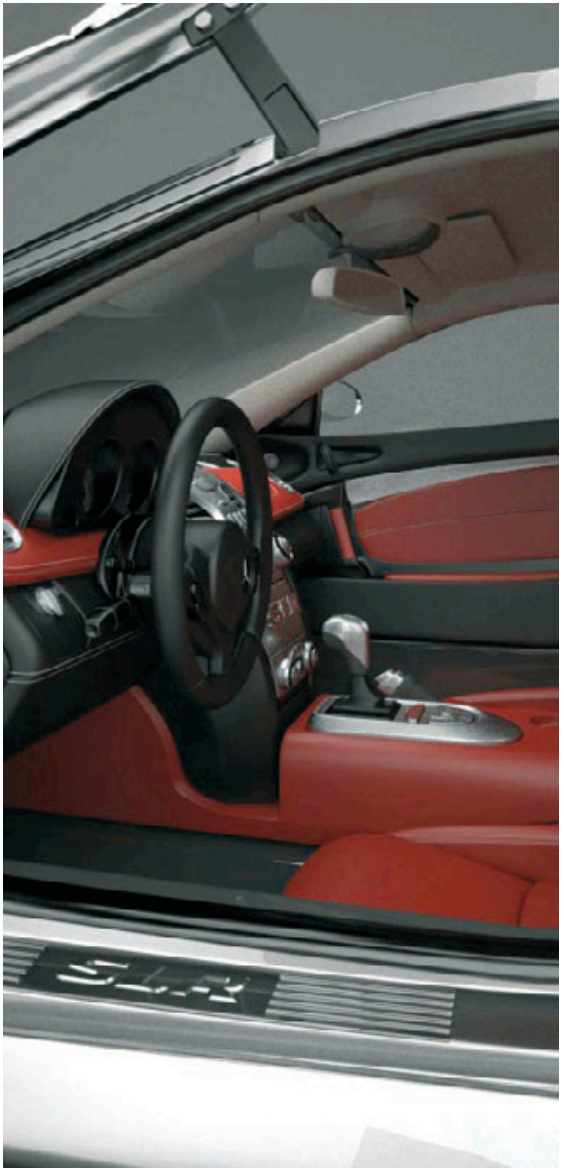
Maxwell Render's algorithms and equations reproduce the behavior of light in a very accurate way. All of the elements in Maxwell Render™, such as light emitters, material shaders and cameras are entirely based on physically accurate models.

Maxwell Render's method of calculation always converges to the correct solution without introducing artifacts due to the fact that it is an unbiased render. Unbiased means that no tricks or interpolations are used to calculate the lighting solution in every pixel. It can fully capture all light interactions between all elements in a scene. All lighting calculations are performed using spectral information and high dynamic range data.

Maxwell Render™ operates as a stand-alone command line application that targets many different environments of the high-end rendering market: architectural visualisation, product design, jewelry, film production, and scientific research. Maxwell Render™ has been built for Windows 32 and 64 bits, Linux 64 bits and Mac OS X UB platforms. This version includes plug-in connections to 3ds Max, VIZ, XSI, Maya, LightWave, Rhinoceros, SolidWorks, Archicad, CINEMA 4D, form•Z, SketchUp and indirectly AllPlan and solidThinking (not supported by Next Limit). Additionally, other file formats are supported such as OBJ, STL, LWO, XC2, DXF, 3DS and FBX.

Maxwell Render™ includes features such as a material editor, material browser and library, texture mapping support, light and camera editors and sky and environment options (all based in physically accurate models). The 1.6 version provides both GUI and command line functionality.





MAXWELL RENDER™ 1.6 FEATURES

RENDER ENGINE CHARACTERISTICS

Physically Correct

Maxwell Rendering technology is strictly based upon the real governing physical equations of light transport. Maxwell Render™ is capable of producing incredibly realistic illumination results without having to resort to illumination tricks. Consequently the results produced by Maxwell Render are highly accurate renditions of the real world.

Spectral Calculations for Light and Object Properties

Most render engines perform calculations in a specific colour space (typically RGB). However, in harmony with reality, Maxwell Render™ considers light as an electromagnetic wave defined by a frequency spectrum (ranging from the Infrared to the Ultraviolet). Once Maxwell Render™ has completed the rendering procedure, each pixel in the output image contains different amounts of spectral energy sourced from the light in the scene. Maxwell Render™ stores this information in a proprietary format called MXI (high dynamic range format). The pixel colour which is generally the final desired result is an interpretation and sensation of the different frequencies which arrive at the film/sensor or the retina. Maxwell Render™ simulates this process and ultimately transforms the spectral measures into known colour formats such as RGB.

Full Global Illumination

Maxwell Render™ calculates all possible interactions between light and the objects within a scene. The global illumination interacts with surfaces and also layers beneath the surface to produce translucency and subsurface scattering effects. Thanks to Full Global Illumination, any scene containing complex caustics can be simulated in a realistic manner. These include reflection and refraction caustics produced by indirect or direct lighting, caustics produced by dielectric materials, plastics or glossy metals. No restrictions at all are imposed on the nature or the number of caustics in a scene. Maxwell Render™ also computes full global illumination effects for moving objects i.e. a moving glass object producing caustics will produce blurred caustics and even volumetric blurred caustics if a participating medium exists.

Unbiased Rendering

Maxwell Render™ is an unbiased render engine. Unbiased means that, with sufficient render time, the rendered solution will always converge to the correct result without the introduction of artifacts. Other render engines based upon widely known techniques such as photon mapping, radiosity, light maps, irradiance maps or other interpolation methods always produce biased renders. Consequently, they cannot guarantee convergence to the correct solution no matter how much time is expended on the rendering process.

TECHNICAL CHARACTERISTICS

Multiprocessor

Ⓝ Maxwell Render™ can exploit all of the processors available on your system and can make them work simultaneously on the same render to provide faster renders. For example, on a multiprocessing platform with eight processors a user can expect up to an eightfold increase in render performance/speed. Voxelization is also multithreaded making the engine 100% multithreaded in this last version

Multiplatform

Maxwell Render™ is a standalone application compatible with Windows 32 and 64 bits, Mac OSX UB and Linux 64 bits.

Cross-platform

There are also a series of plug-ins connecting Maxwell Render™ to the most popular 3D applications including 3dsMax, Maya, Cinema 4D, LightWave, XSI, Rhino, SolidWorks, SketchUp, Form-Z, and ArchiCAD. However, an alternative workflow is possible using Maxwell Render™ Studio, a 3D application to set up your scene. All the plugins have been re-written or heavily improved within this version or the previous one and we will continue doing so for next versions.

Geometry Accepted

Maxwell Render™ is not a full 3D application but a render engine, so modeling within Maxwell Render™ is not possible. Instead, Maxwell Render™ needs polygons to be able to light and shade surfaces. So a lot of polygonal formats are accepted, like dxf, obj, and lwo among others. Furthermore, plug-ins convert other types of geometry to polygons internally so that things like nurbs and surfaces are still renderable.

Instances

Ⓝ Maxwell Render™ now has the possibility to generate instances from almost all available platforms. This is a great enhancement in memory terms as multiple copies of objects will now have little impact on memory consumption.





Preview Engine

Maxwell Render's preview engine is called RS0, as opposed to RS1, which is the render engine. This preview engine is faster and lower in quality than RS1 and it has been improved for this version.

Core Engine

The RS1 engine brings the quality of rendered images to a completely new level. Memory-intensive tasks such as glare, Multilight™ with a lot of emitters, large geometries and a lot of heavy textures are easy to handle for an average computer. The MXCL interface is easy to use and intuitive.

Command Line

Maxwell render has the possibility to make the render via console. This results in a faster render as no application is launched and provides versatility as well.

Resume Render

MXI files can always be resumed, allowing users to refine the render even after it has been stopped, as many times as you want.

Log System

Log system with more information, warnings and error messages to keep track of your renders. You can view full log in the console window of Maxwell Viewer.

Memory Handling

Maxwell Render's efficient memory handling makes it possible to render at very high resolutions (for example at 6000 x 6000 with less than 2 GB of RAM) without losing quality. High-res images are just a mouse-click away now.

File Management System

The efficient File Management System within Maxwell Render manages external files needed for the render, such as images, IOR files, r2 files, MXI, etc... It includes options for default paths, automatic handling of missing paths and files, detecting low size on disk to save MXS and MXI files and more.

LIGHTING

Objects as Light Sources

Lights in Maxwell Render™ are defined by applying an emitter material to an object. This innovative approach to simulate lights emulates what happens in the real world producing a higher degree of realism in comparison to traditional render engines outputting smoother shadows and increasing the overall quality. Another important characteristic of the Maxwell Render™ engine is the number of lights that can be placed in the same scene. Most other render engines cannot handle a large number of area lights without incurring a significant performance loss. Light sources in Maxwell Render™ are defined by spectral characteristics. Thus a light source can possess a lot of information about the intensity of emission at any of the possible wavelengths.

Environment

Ⓝ Using Maxwell Render™, the user can choose from three different types of environments. The first one is a sky dome, defined by colour plus intensity. Sky dome now has the ability to use sunlight from the Physical Sky. Users can also choose for a HDR/MXI environment to make use of lighting information of high dynamic range image formats. It is also possible to use a physically-based sky simulator or physical sky, where the user simply specifies the geographical location and the time of day for a scene and Maxwell Render™ automatically handles the rest.

Multilight™

Multilight™ is an advanced tool for editing lighting. It allows changing the intensity of individual lights during and after the rendering process. These changes affect all global illumination and lighting aspects of the scene. Multilight™ is also a real compositor that can produce a lighting animation from a single render. It is possible to save each emitter in a separate layers for each frame.

It also works with other characteristics of the MXI format, making the Multilight™ system compatible with SimuLens™.





SHADING

Materials Based On Real Optical Properties

Maxwell Render™ materials are defined in a physically correct manner from their **BSDF** curves (Bidirectional Scattering Distribution Function) adding the ability to superpose different layers of physical materials in the same object like other BSDF or **SSS** (Sub Surface Scattering) effects. Thin coatings are also available for very subtle and realistic effects (for creating thin film interference effects such as the multicoloured look of a thin layer of oil in water, or soap bubbles). The improved calculation of **IOR data** provides the possibility for users to use IOR data files directly measured in laboratories. This allows for easier rendering of real life materials.

Maxwell Render™ materials are not only physically correct but also very flexible and versatile. They allow for the creation of special materials such as **Opacity Maps** and **Clip Maps**. **Normal Mapping** is also supported and it is possible to set the intensity of Normal mapping with bump value.

Emitter Materials are defined in a very intuitive way, using everyday terms like watts or efficacy. Emitter materials can be mixed with BSDFs as well. In this way, if the light is “on” only incandescence can be seen. But if the emitter is “switched off” the base material (metal, crystal… any material) will be revealed.

The **Matte Material** “flag” turns the assigned material into an invisible object, directly showing the environment. This is very useful for compositing rendered images with photos.

Dispersion is a phenomenon that causes the separation of a wave into spectral components with different wavelenghts, causing white light to separate into the colours of the rainbow. It commonly happens when light goes through transparent materials. Dispersion is an important touch for realism, especially when rendering things like jewels, or certain dielectrics and of course it is available in Maxwell Render™.

Displacement allows you to render virtually detailed surfaces without having to model those details. Using a greyscale map, you specify how the surface should be displaced. Maxwell’s unique displacement method allows you to create virtually infinite surface details while using little extra memory. (N)

Material Library and Wizards

Among the possibilities to create and edit your own materials, Maxwell Render™ offers wizards to quickly create materials. Maxwell Render™ materials can be stored in independent MXM files (Maxwell Render™ material file), so you can make your own material libraries. To get you started, Maxwell Render™ comes with a material library with more than 200 ready-to-use materials.

Also, the Maxwell Render™ material site (http://mxmgallery.maxwellrender.com) has been created for users of Maxwell Render™ to share their materials with other users. The site continues to be a great success in a short period of time, just like its contests – more than 2000 materials are freely downloadable!

Material Editor

Material Editor is the ideal tool for creating Maxwell materials. It offers the quickest, most efficient way of creating and reviewing MXM files.

Some of its characteristics are:

Texture Bin

A small panel inside the material editor allows you to quickly see all the textures in your scene, and drag & drop a texture from the panel into one of the texture slots.

Texture Editor

The texture editor gives you the option to view the loaded texture at full resolution.

Drag and Drop functionalities

You can now copy textures and colours by dragging and dropping on other texture or colour chips (even from different BSDF or coatings).

Plug-ins interpret native shaders

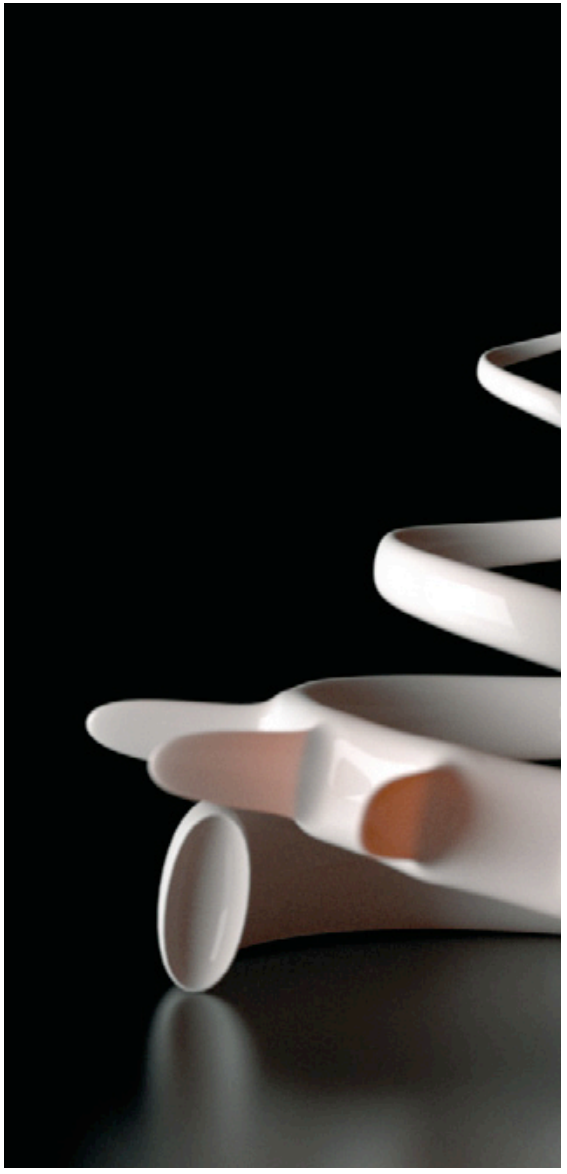
The new generation of plug-ins which started with the re-writing of the Maya plug-in is able to interpret the 3D platform's native shading to a greater or lesser extent.

CAMERAS AND EFFECTS

Realistic Camera Model

Cameras in Maxwell Render™ operate completely differently to those in other render engines. Traditionally, most render engines use a pinhole camera. This type of camera simulates a tiny hole that allows light rays coming from the scene to reach the viewing surface. Maxwell Render™ simulates a real camera with the associated lens set, diaphragm aperture, diaphragm blades etc. By using this type of camera model Maxwell Render™ can automatically simulate depth of field, motion blur effects, image distortion and aperture diffraction due to the lens set. Other render engines currently on the market use post-render filters or special tricks to create these effects.

Maxwell Render™ does not produce motion blur as a post-process or using various tricks. Instead Maxwell Render™ considers the moving objects to have random positions along their trajectories during the camera shutter speed time. This creates a natural and realistic motion blur. Some improvements in this area have been made for this version and now motion blur computes Clip Maps and Opacity Maps perfectly.





SimuLens™

Diffraction happens when light goes through small holes (apertures) and behaves like waves. It is very important in optics, as it explains why a perfect telescope (or microscope) that can take a photograph of a star and render it as a single dot instead of some circles (halos) or streaks. Maxwell Render's SimuLens™ system allows the user to define a pattern to simulate the shape of the diaphragm that will model the pattern of light reaching the camera film, creating realistic lens diffraction effects (glare). Furthermore, users can add a second pattern which defines "obstacles" in the lens such as dust, fingerprints or eyelashes adding to a more realistic diffraction effect.

Lens Scattering

Is a parameter part of SimuLens™, which simulates the scattering of light inside a lens system. This effect is typically called "bloom" and users can control the amount of lens scattering.

These advanced controls brings a new level of quality and realism to computer graphics. Users can have control over Diffraction, the frequency of Diffraction, and also Lens Scattering to simulate blooming effect. Also Vignetting control has been incorporated. Vignetting is the darkening effect that happens on real world lenses, especially wide angle lenses. It's now possible to remove this natural darkening partially or completely from your renders.

All these features are combined under Maxwell Render's SimuLens™ system which is also compatible with Multilight™.

OTHER RENDER FEATURES

ZClip Planes

You can cut your rendered object with far and near planes and the render will show the interior of the object, without the need to model the edges. Excluding desired objects from ZClip is also possible.Very flexible and useful.

Shift Lens

This camera parameter allows you to shift the film plane up/down and left/right, without rotating the camera. This is very useful in architectural rendering for keeping a two point perspective while capturing the entire building in the image.

WORKFLOW

Maxwell Render™ provides two alternative workflows. One method allows the user to use their existing 3D package and the appropriate Maxwell Render™ plug-in to send scene data to the render engine (MXCL). The other method allows you to import objects into Maxwell Studio (MXST) where you create/edit/assign materials, set up lights and cameras and MXST then sends the scene to MXCL.

Maxwell Studio

Maxwell Studio has been improved for this version. The performance and stability have been the main focus for this version.

Among a lot of characteristics we highlight:

OpenGL® performance

Optimizations in performance were made and big scenes with lots of textures are now easy to handle. Other special features are available like the transparent shading of dielectrics in the viewports.

Blow Up

This feature allows the user to choose a region of the viewport and render it at the final resolution chosen. It is ideal for rendering details without having to set a new camera.

Exporting options

(N) Users have the option to export selected geometry like MXS or obj.
Exporting as MXS will also export the material(s) attached to the object(s).
Export to obj and MXS is protected by the user who created the MXS from the corresponding plug-in by a tag in the plug-in interface. This tag has been included in more plug-ins for this version.

Support to instances

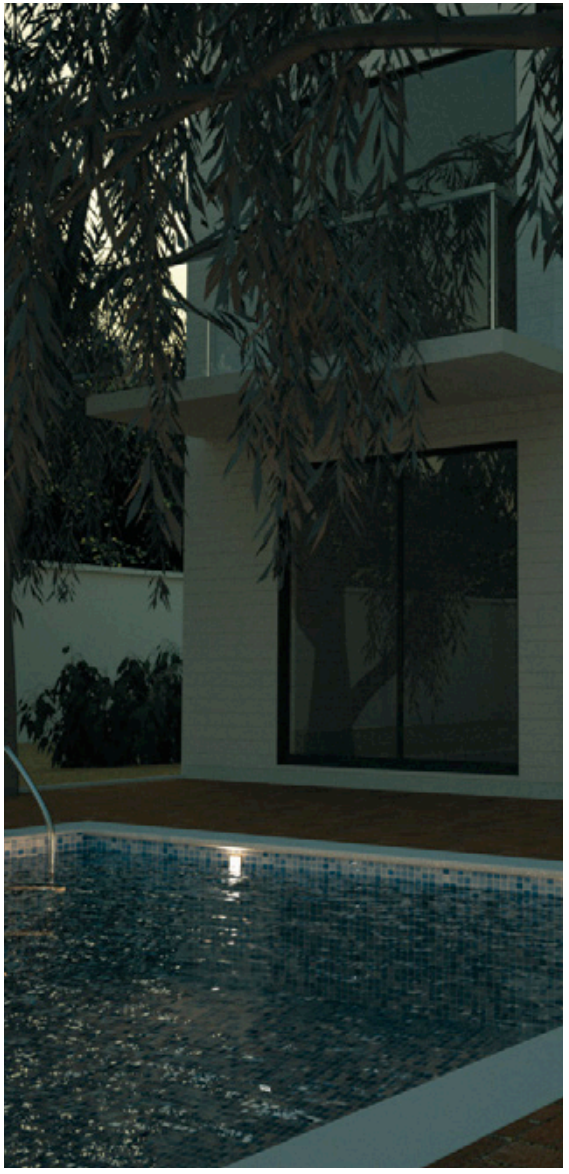
(N) Instances can now be generated via most of the plug-ins and are a big memory saver when making multiple copies of an object. You could have for example 10,000 instances of an object, and during rendertime, MXCL will use the same amount of memory as if you were rendering 1 real copy of that object.

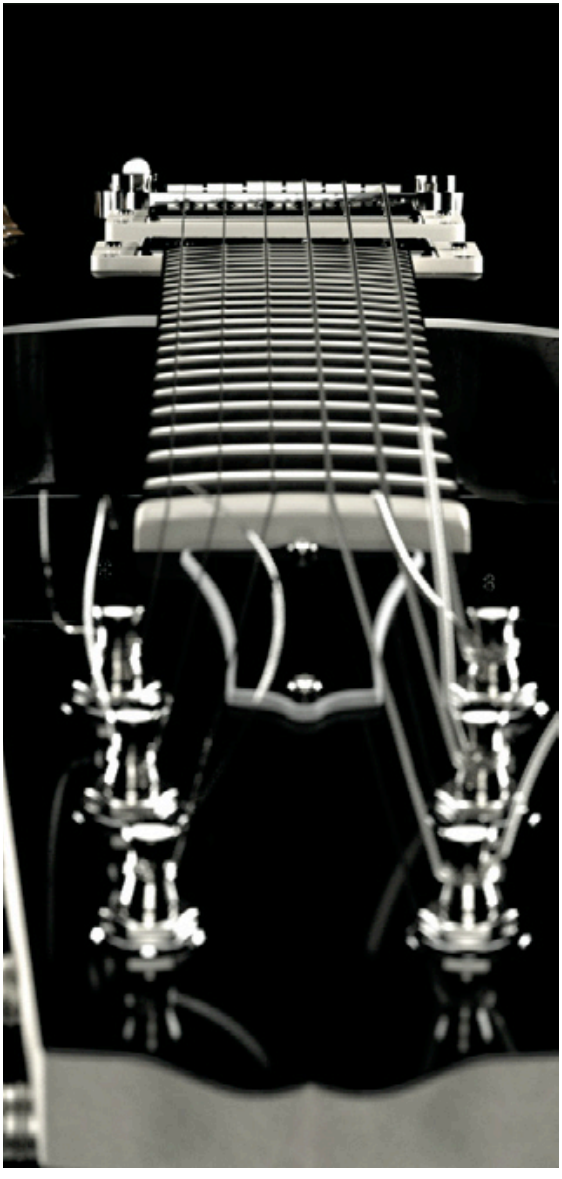
Hierarchies

(N) Nesting groups into groups is now possible in Maxwell Studio. This is important for scene management and to provide an easy workflow for big scenes. You can also parent objects to other objects, or groups to an object.

Transformation and object manipulation

(N) This area has been entirely re-written to improve the workflow and make it more user-friendly, stable and reliable.





Complete History

Maxwell Render™ Studio now keeps track of all scene changes and shows them listed in a history panel. Users can scroll through the history list to undo/ redo changes. The history list can also be purged.

UI

Maxwell Render™ Studio's user interface has got a good organization, thought for a versatile use and a fast workflow. Also layouts can be configured, stored and exchanged.

Some of its characteristics are:

Customizable shortcuts

Object panel displays applied materials to the right of the object name, inside the object list for a faster overview of applied materials.
Object parameters panel has been fused with triangles and projectors panels. Parameters panels have been redesigned for collapsing and expanding groups of settings individually.
Graphics, icons and the possibility to change layout aspects.
Icon size in object list and material list can be switched between small/medium/large.
MXI/HDR textures can be dropped from one slot to another. Settings for one slot can be quickly copied to all slots.
Decimals precision can be defined by the user globally or per parameter. (N)
A "City" list has been added to Physical Sky, which loads a list of cities from a text file. Cities can be added/ removed easily from the list by editing the text file.
Automatic GMT – when setting a certain location, Studio automatically sets the correct GMT for that location.
Ability to rotate the Physical Sky system for easier positioning of the sun. Ability to rotate and scale the entire scene, along with the cameras.
New grid options allow you to set the grid in absolute units. (N)
New preferences for the latest changes. (N)
Ability to lock objects or cameras to prevent accidental movement.
New instances panel to show instances of selected object. (N)

New Generation of Plug-ins

This new generation of plug-ins is highly superior to previous ones, and we will continue to improve all plug-ins. Generally, the plug-ins are much more integrated and transparent to users, allowing for a faster workflow, more flexibility and ease of use.

This version includes plug-in connections to 3ds Max, VIZ, LightWave, Maya, Rhinoceros, SolidWorks, Archicad, CINEMA 4D, form•Z and SketchUp and there are currently more plugins being made by third parties.

OUTPUT

MXI

MXI is the Maxwell Render™ proprietary high dynamic range format. It stores lighting information per pixel and per light individually (if Multilight™ is enabled) along with RGBA values, as opposed to common 24 or 32 bits images that can only store RGB or RGBA values.The MXI format is more powerful now. It allows users to Resume and it is compatible with SimuLens™ and Multilight™. Its size is around 3.5 times smaller than in previous versions, indirectly enhancing other features like Networking.

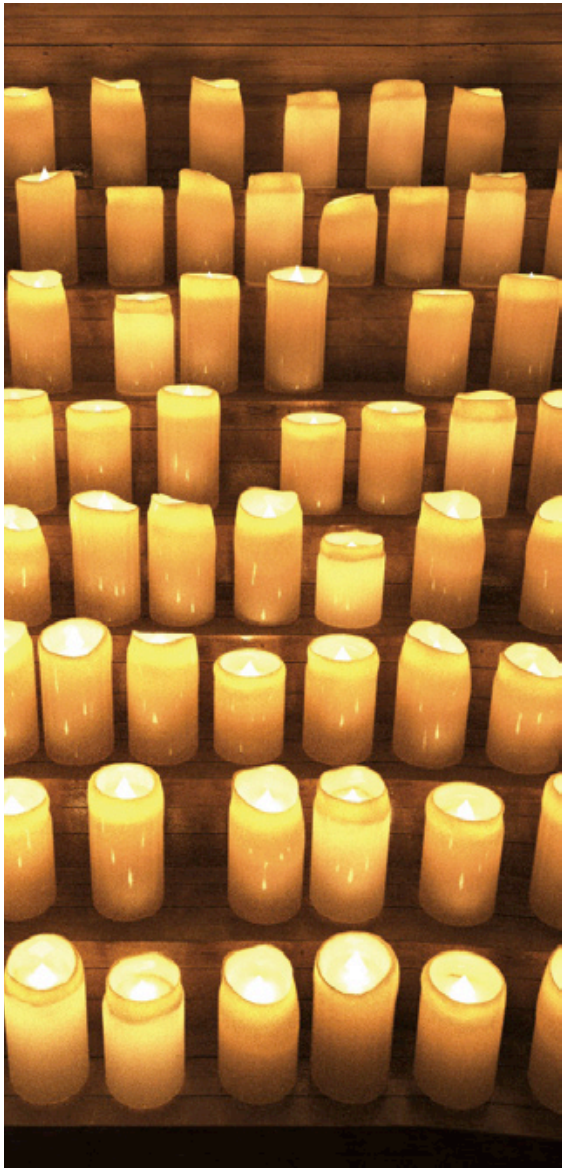
Other formats

Of course, Maxwell Render™ can export to most common formats like JPG, PNG, TGA... and also in 32 bits and HDR as well.

Supported texture formats

Ⓝ These have been greatly expanded to allow many different image formats to be used as textures. The following table describes which formats are supported:

Format	Colour Space	Bits
JPG	RGB/Grey	8
TGA	RGB/Grey/Index	8
PNG	RGB/Grey/Index	8/16
BMP	RGB/Grey	8
TIF	RGB/Grey/Index	8/16/32
J2K	RGB/Grey	8/16
PPM	RGB/Grey	8/32





Render Channles

Maxwell Render™ can export different layers for compositing purposes:

- Render
- Alpha
- Shadow
- Material ID
- Object ID
- ZBuffer

Among the enhancements in this area we can highlight the new Shadow Layer, which simulates the cast shadows of the materials with the “Shadow” Flag enabled.

NETWORK RENDERING

The Maxwell Render™ Network system allows jobs to be sent individually to each machine on the net, rendering animations and frames. It is even possible to let all machines render the same frame individually and merge the images that have been created at the end of the rendering process. It has some further useful functions like grouping nodes for exclusive assignment or displaying jobs. (N)

Maxwell Render’s networking was vastly improved and optimized and it is now more stable and faster.

We have included new functionalities for more versatility and usefulness:

Several managers

It is possible to set up several managers on a network and assign servers and jobs to different managers. Creating complex systems on big networks raises the reliability. Managers can now also be called by machine name instead of just by IP address. (N)

Global Sampling Level

Sampling level for cooperative jobs can be specified as a global sampling level. This largely requested feature is now available to make the use of networking as easy as ever. (N)

Displaying jobs

One of the most powerful feature of the Job Queue window is the Display function. While servers are rendering you can select any of them and when you press the Display button it will automatically reveal the image being rendered on that node. Display button also supports instantaneous viewing of a cooperative job as merged during the render progress.

Redesigned UI

Maxwell Render engine (MXCL) interface has been designed to make Network rendering comfortable to the user.

Selection of servers

Selection of servers can be specified by name or IP.

SDK

Maxwell Render™ Software Development Kit is available upon request and proposal evaluation.

We can highlight the following characteristics:

- MXS file creation is faster and safer.
- Support for new features.
- New platforms supported.
- Available for OS X, Win 32 and 64 bits and Linux 64 bits.

If you are a developer and are interested in Maxwell Render's SDK, please send us an email explaining your interest to http://www.nextlimit.com/sales_support.htm.

COMMUNITY AND LEARNING

Smart Community

Maxwell Render™ offers a variety of learning resources like manuals, tutorials, videos, forums and a very open and friendly community. Maxwell Render™ users are enthusiastic people and we like to call them "the smart community" because they share, talk and learn from each other with respect and passion. Lead by the A-Team (Maxwell Render™ experts and testers), you can also become part of this adventure.

Also, the Maxwell Render™ resources center (http://think.maxwellrender.com) has been created for users of Maxwell Render™ to share their knowledge with other users. It includes tutorials, tips, videos and documents. Some of them are even translated to different languages and it is in short, a growing reference for the community.

Learning Curve

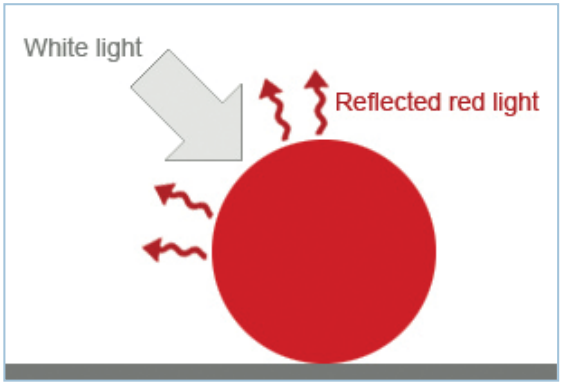
Maxwell Render™ is very easy to learn but it is also flexible enough to allow for in-depth technical tests, reviews or renders if that is what you are looking for. Also, the Maxwell Render™ resources center (http://think.maxwellrender.com) has been created for users of Maxwell Render™ to share their knowledge with other users. It includes tutorials, tips, videos and documents. Some of them are even translated to different languages and it is in short, a growing reference for the community.





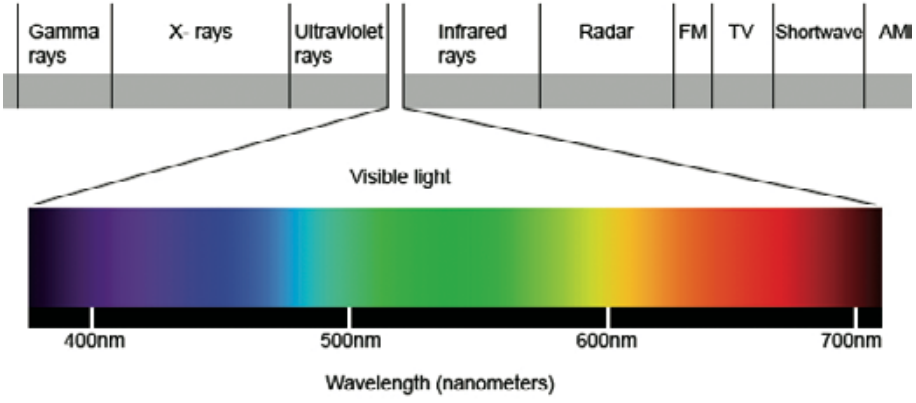
MATERIALS: INTRODUCTION

Before explaining the material parameters used in the Maxwell material system, it is important to have a basic understanding of what light is, how it interacts with materials and why a material looks shiny, dull, transparent etc. Please review this information as it will make the parameters in the Maxwell material editor much easier to understand.



WHAT IS LIGHT?

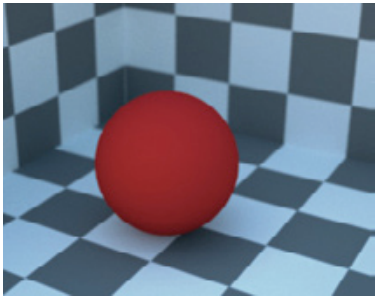
Visible light is really a very small portion in a range of electromagnetic radiation. This radiation travels in waves of different wavelengths. The difference in wavelengths (the “tops” of each wave) is what makes the difference between blue, red, gamma rays, x-rays, radio waves etc.



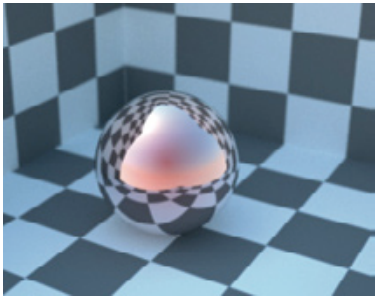
“White light” is a combination of all the colours in the visible light spectrum and when we perceive an object as red for example, what happens white light falls on the red surface, and all the wavelengths except those that give red light, are absorbed by the material. Only the red portion of the spectrum is reflected back.

DIFFUSE – SPECULAR & REFLECTED LIGHT









We see an object because light is reflected from its surface into our eyes. That is, ALL light is *reflected* light. This may sound confusing at first because it has become common in renderers to refer to reflected light as specular (or sharply) reflected light.

In the real world light doesn't have a separate "diffuse" or "specular" part. So what makes a surface look dull, or mirror like? It is the smoothness of its surface.

A surface which is not very smooth has tiny imperfections which scatter the light in all directions, thus creating a very "diffuse" reflection of its environment:

A surface which scatters almost all light in a chaotic, diffuse way is called a lambertian surface, such as the red ball in the above image.

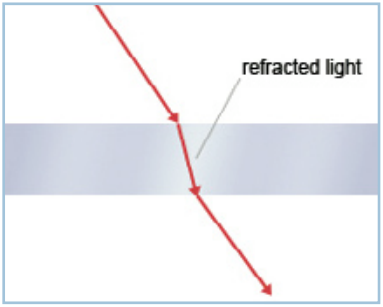
A smooth surface however reflects light uniformly and creates a very sharp, or specular reflection of its environment:

It is important to note that because very smooth surfaces perfectly reflect, they reflect much less of their own colour. This is visible in the in the render on the left, where the ball is still tinted red, but since it is virtually a tinted mirror, its own colour shows much less. There are a few exceptions however and one of them is metals. Even if they are very smooth they reflect their own colour much more. The environment they reflect will become much more tinted by their own colour.

TRANSPARENCY

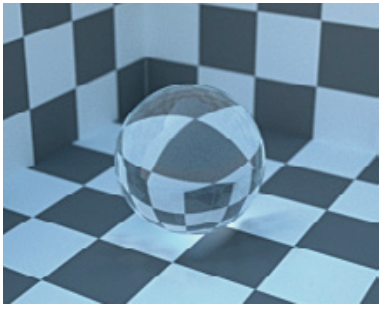
An object becomes transparent when light doesn't stop at the surface, but goes through the object and out the other side. When light passes through a material, it slows down because the material is denser than vacuum. Because of this change in speed, the light is bent, or refracted when going from vacuum (or air) into the material. This refraction occurs whenever light changes speed, so it happens when it moves from one material to another with different densities. The refraction is also what causes "caustics", concentrated pools of light.

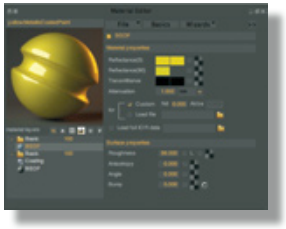
In the render on the right, it is refraction that makes the checkered pattern look distorted, and makes the caustics pattern. Different materials slow down light more, or less, relative to the speed of light in air or vacuum. This difference between lightspeed in vacuum <–> lightspeed in medium, is specified as the index of refraction (IOR) for that particular medium.

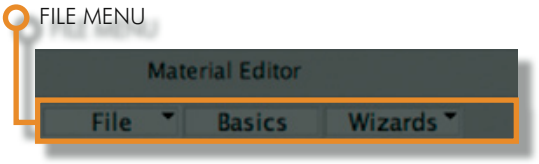


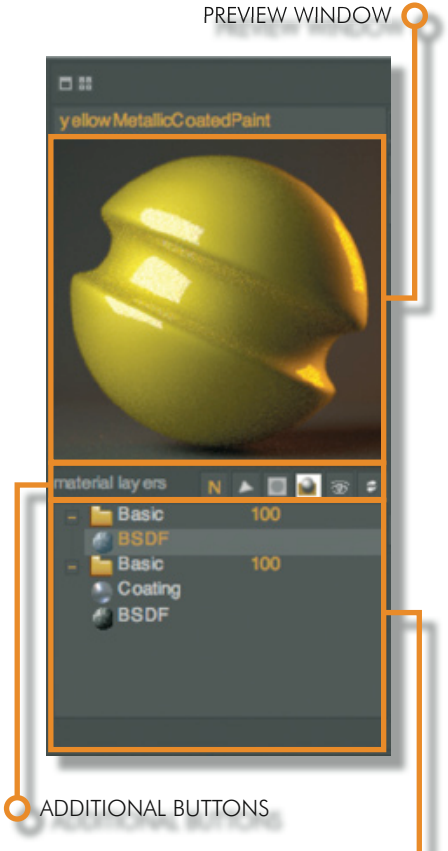
THE FRESNEL EFFECT

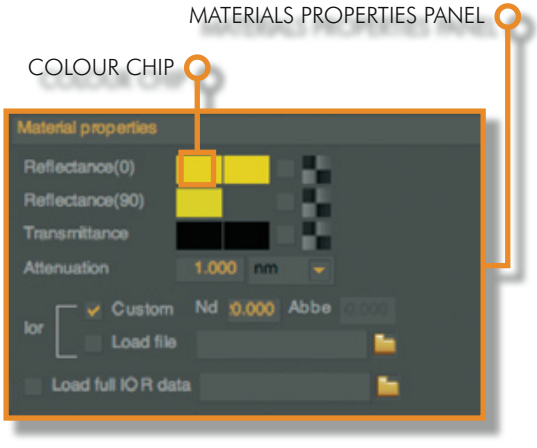
The Fresnel effect is the apparent increase/decrease of a surfaces reflectance based on viewing angle. For example if you look at your monitor screen straight on, the monitor glass shows almost no reflection, but if you look at it from an angle almost parallel to the glass, it has become very reflective. The Fresnel effect is dependant on the IOR of the material. The higher the IOR, the more reflective the material becomes at ALL angles, so the fresnel effect diminishes – the material becomes equally reflective at all angles.

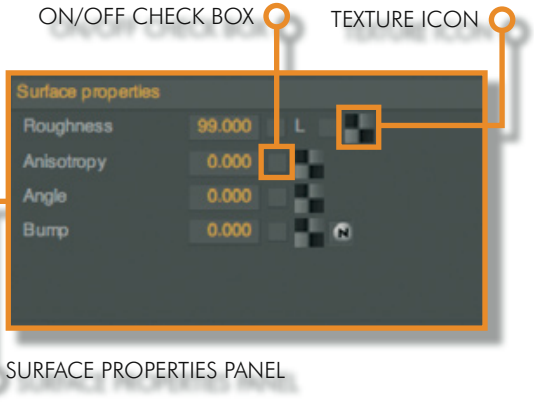


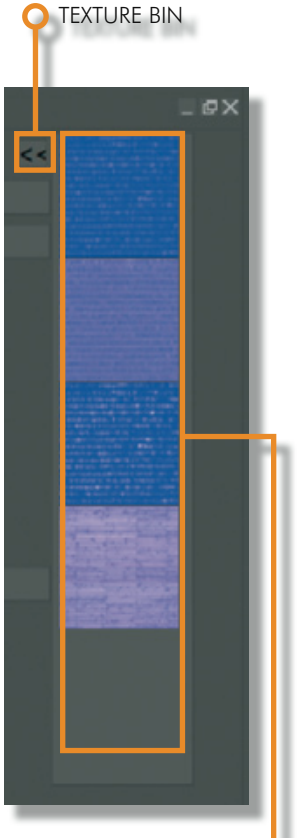



FILE MENU
Material Editor
File
Basics
Wizards


PREVIEW WINDOW
yellowMetallicCoatedPaint
material layers
Basic 100
BSDF
Basic 100
Coating
BSDF
ADDITIONAL BUTTONS
MATERIAL COMPONENT WINDOW


MATERIALS PROPERTIES PANEL
COLOUR CHIP
Material properties
Reflectance(0)
Reflectance(90)
Transmittance
Attenuation
1.000
nm
Ior
Custom
Nd
0.000
Abbe
Load file
Load full IOR data


ON/OFF CHECK BOX
TEXTURE ICON
Surface properties
Roughness
99.000
L
Anisotropy
0.000
Angle
0.000
Bump
0.000
SURFACE PROPERTIES PANEL


TEXTURE BIN
<<
TEXTURE BIN

MATERIAL EDITOR

The material editor is one of the most important areas of Maxwell. It provides a powerful set of parameters for advanced editing of a Maxwell material. The four main areas of the material editor are:

A) Material Components

Maxwell's materials can be composed of different layers and each layer includes one BSDF, a coating and a Subsurface Scattering (SSS) component. Emitters and Displacement are also defined here.

B) Material Preview

Provides a quick preview of the material. Preview options are accessible via rightclick.

C) Material Properties

Parameters to control the main optical properties for each material component (BSDF, coatings, etc).

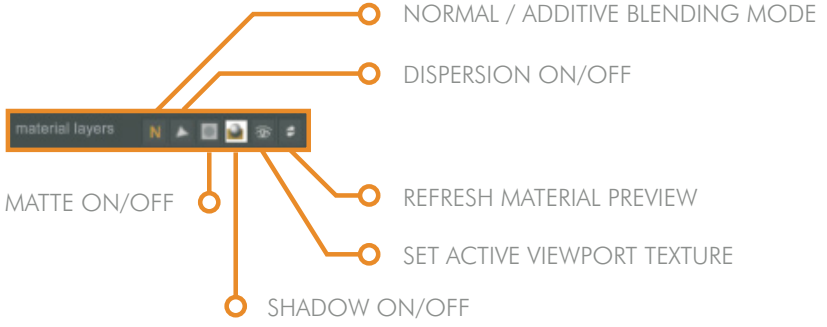
D) Surface Properties

Parameters to control surface properties of a material.

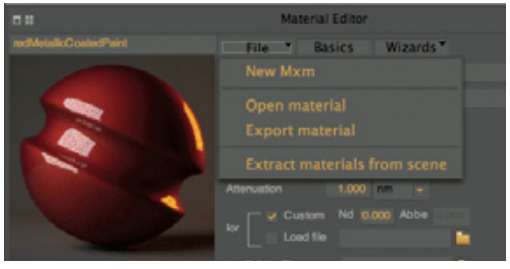
MATERIAL EDITOR



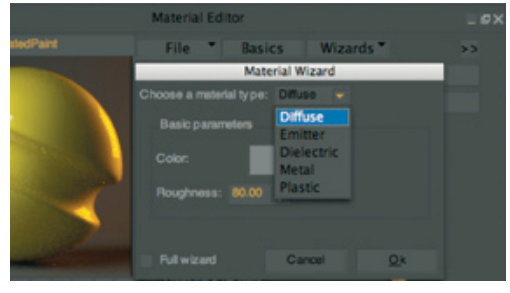
The material components area also contains six buttons to control various aspects of the material and material editor:



FILE MENU



BASICS MENU



BSDF (Bidirectional Scattering Distribution Function) is a mathematical function that describes how light is scattered by a surface. The BSDF basically represents the optical properties of the main volume of the object, whether diffuse, metallic, dielectric…

FILE MENU

The File menu in the material editor has the following options:

New MXM

Creates a new material.

Open material

Lets you load a .mxm file (Maxwell material file). The material will be loaded into the material editor as well as added to the scene material list (if Studio is used).

Export material

Lets you export the currently loaded material as a .mxm file (Maxwell material file).

Extract materials from scene

Lets you choose a .MXS file and extract all the materials in that scene to a folder of your choice.

BASICS MENU

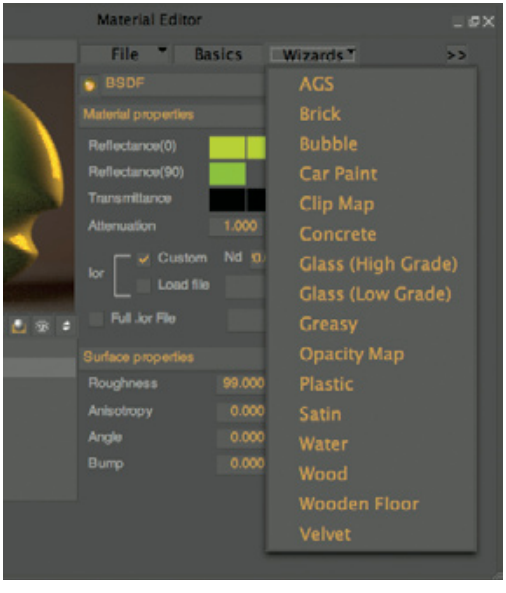
This is a helper for creating materials, similar to the Maxwell beta style material creation. You can create five types of basic materials: Diffuse, Emitter, Metal, Dielectric, Plastic. Note: You must first create a new material using File > New Mxm for the material to be added to the material list, then you can use the Basics button to adjust the material.

WIZARDS MENU

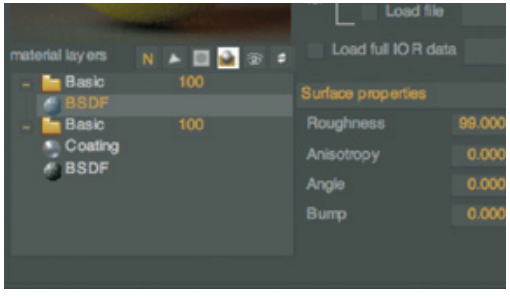
This feature is a step by step guide to creating several types of common materials such as Wood, Concrete, Bricks, Clipmap etc… The Wizards will ask you for textures, bumps, reflectance maps and material values such as roughness and colour.

Note: You must first create a new material using "File > New Mxm" for the material to be added to the material list, then you can use the Wizards button to adjust the material.

WIZARDS MENU

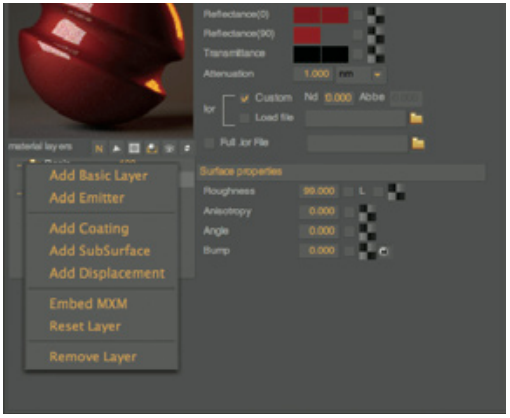


MATERIAL LAYERS



Keep in mind that a BSDF can be any kind of material (dielectric, diffuse, metal…) and that coatings are always transparent as they are very thin. Also any of these layers can not only be a BSDF, but only a coating or SSS component for example. Very complex materials can easily be created this way.

ADDING/REMOVING LAYERS



MATERIAL LAYERS

Maxwell materials can contain several layers, and each layer can include one BSDF component, one coating component and one SSS component:

MAXWELL MATERIAL
- Basic Layer 1
- Coating
- BSDF
- SSS

BASIC LAYER 2
- Coating
- BSDF

Layers can be controlled through a general strength factor or a weight map, and can be set in a normal or additive mixing mode. More detailed info about these concepts in the following pages.

ADDING/REMOVING LAYERS:

In the material component panel, Rightclick in the panel. The following menu appears:

Add Basic Layer
This option creates a new layer with one BSDF. Only one BSDF is allowed per layer.

Add Emitter
Adds an emitter component. Emitters can be mixed with a material, for example if you have this material applied to a lightbulb, when the emitter is on, it will shine light on the scene just like a regular emitter, and when turned off, it will reveal the glass bulb material. Only one emitter component is allowed for the whole material.

Add Coating
Adds a new coating to the selected layer.

Add Subsurface
Adds subsurface component to the selected layer (only one SSS component per layer is allowed).

Add Displacement
Adds displacement component to the current material. Only one displacement component is allowed per material

Embed MXM file
Imports an MXM (Maxwell material file) into the current material. The new materials layers are added to the current layers.

Reset Layer
Restores default parameters in currently selected layer.

Remove Layer
Deletes the current selected layer. You can click on the folder icon to delete all the components in the layer, or click an individual component to only delete the selected component.

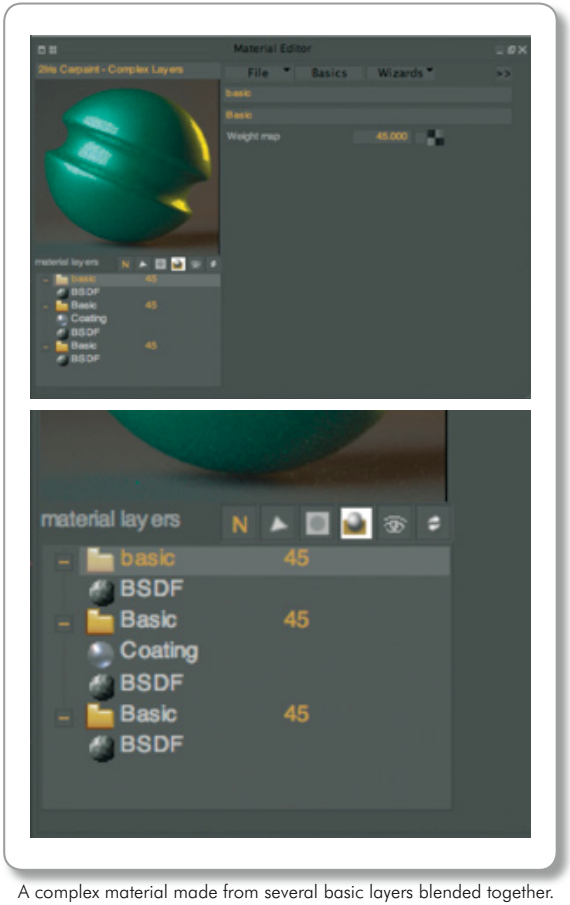


Example of MXI emitter added to a material.



Material + Emitter layer and glass emitting light.

For example if you have this material applied to a lightbulb, when the emitter is on, it will shine light on the scene just like a regular emitter, and when turned off, it will reveal the glass bulb material. Only one emitter component is allowed for the whole material.



A complex material made from several basic layers blended together.

LAYER WEIGHTING

As mentioned earlier, the influence of each layer can be controlled with a weighting factor, or a black and white texture (white means more influence). To change the weighting or add a texture to the weighting, click on the folder icon of the layer, and in the main area, adjust the weighting or load a texture.

The weight value controls the way different layers are blended together. For example, if there are two layers, setting 50 for both layers will produce a 50% contribution of each layer. Using a texture can produce more sophisticated blending between layers.

Layer weighting is always normalized internally by Maxwell, meaning if you have 3 layers, weighted at 40, 50, 70 respectively, their added contribution will not exceed 100. Their real contribution will then be 25 / 31 / 44 (40+50+70=160: 40/160=25, 50/160=31, 70/160=44). This means you don't have to worry that the total weighting of all layers will exceed 100 and produce unnatural results.

The current weighting of the layer is displayed to the right of the layer folder. If a texture is used to weight the layer, a "T" will appear instead of a number.

The order of the basic layers does not interfere with the material behavior. The contribution of each basic layer is only determined by its weight and the blending mode enabled (Normal or Additive – more about this on the following page).

BLENDING MODES:

Each Maxwell material can be blended in one of two modes: Normal or Additive. It is important to understand that this blending mode applies to the whole material, not to individual layers.

Change blending mode by clicking on the Blending mode button.

Normal mode

Should be used when making materials that are “fused” together, such as a mix of metals, or different coloured glass.

Additive mode

Should be used when making materials that are mixed one on top of the other, such as rough molded plastic with a clear smooth coating applied on top, ceramics with smooth coating, laquered wood etc...

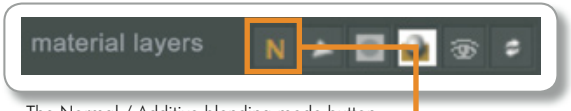
MATTE MATERIAL

This option turns the material into a matte material which “cuts” through the entire image and reveals the background (for example physical sky if it’s enabled, or black if no environment lighting is used). This is useful for compositing purposes, for example if you have columns in front of a character, and the columns will be rendered in another pass, you can turn on Matte material for the columns, and the character will be rendered with the columns “cut” from the character. The columns will still contribute to the lighting, even with matte material turned on.

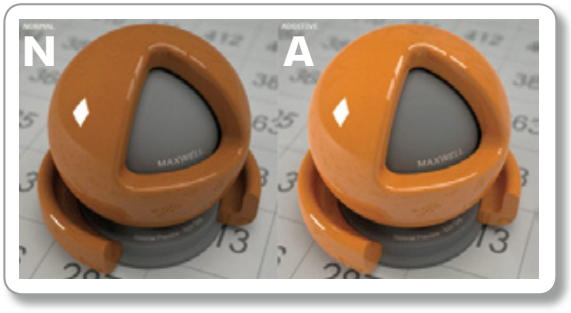


The scene contains a backdrop which has matte material turned on in its material. The resulting render shows the black background, while the backdrop still influences the scene lighing.

BLENDING MODES



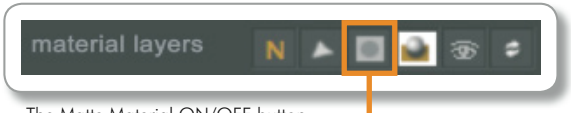
The Normal / Additive blending mode button.



The difference betweem Normal & Additive blending mode.

Example of using Normal (N) Vs Additive (A) blending modes. In this example a clear coated plastic was the desired material, so Additive mode is clearly more suitable.

MATTE MATERIAL



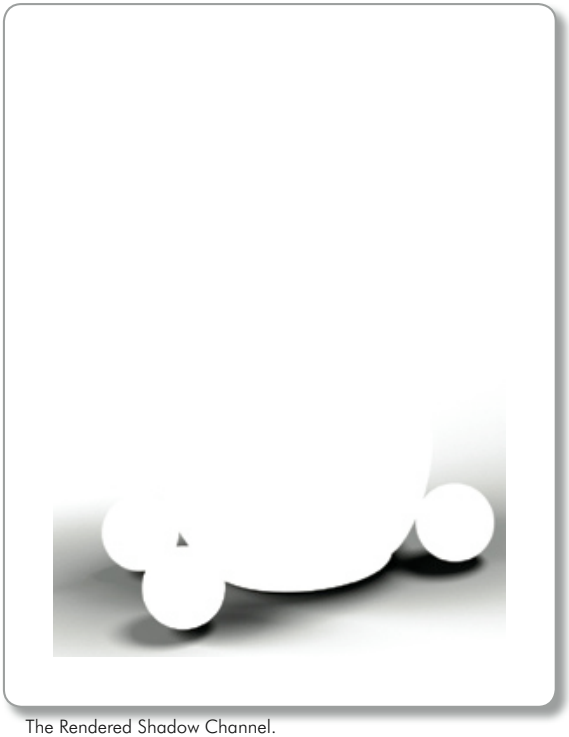
The Matte Material ON/OFF button.

SHADOW CHANNEL



The Shadow Channel ON/OFF button.

SHADOW CHANNEL

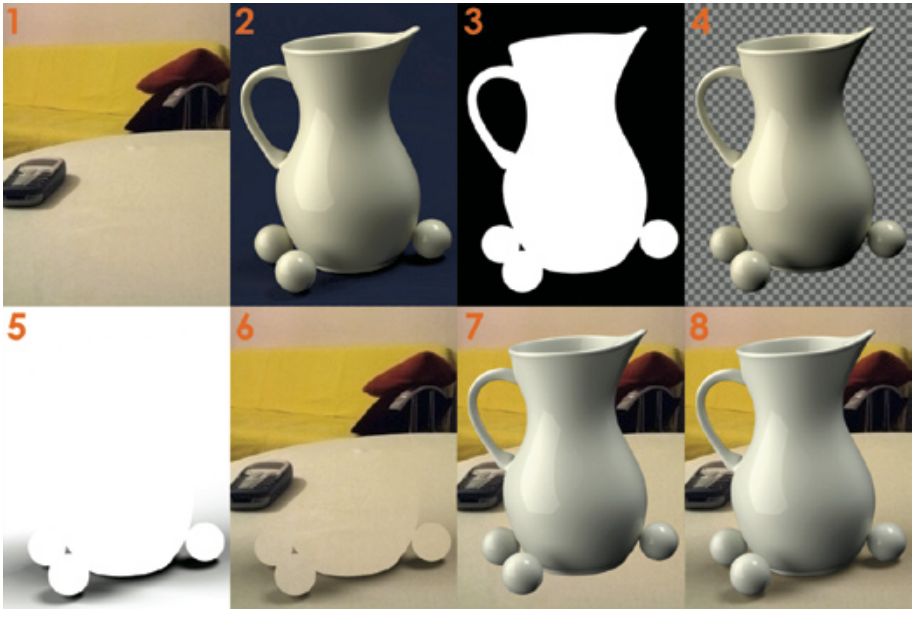


The Rendered Shadow Channel.

SHADOW CHANNEL

Turning on this option for a material will make all objects with this material applied behave as shadow catchers. If you turn on shadow channel in the Render Options panel, all materials that have this option turned on will render shadows only. All materials with this option off will render white. This allows you to render out a shadow only pass for compositing purposes. The following image demonstrates the procedure:

1. Photograph taken to serve as background.
2. Render of a scene.
3. Alpha channel rendered to crop out the background.
4. Objects cropped in Photoshop using the alpha channel.
5. The rendered shadow pass.
6. The shadow pass composited in Photoshop using “Multiply” as the blending mode. Additionally, the shadows can be tinted using a Hue/Saturation adjustment layer in Photoshop.
7. Objects pasted into photograph background.
8. Final composition.



MATERIAL PREVIEW

This panel shows a preview of the current material. To preview a material, click the icon, or double-click on the preview image, or use the "CTRL+P" shortcut. Rightclicking on the material preview, you can access some specific options:

Load scene to preview

The preview window can preview any MXS file. By default it uses the defaultpreview.MXS file in the preview folder (Nextlimit/Maxwell/preview).

PREVIEW OPTIONS:

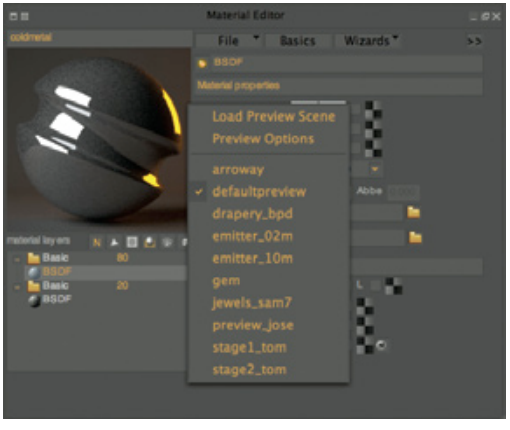
This option specifies the quality and number of bounces of the preview engine. Complex materials may require higher quality settings. These options are also available in the Preferences panel. There are two render engines you can use, the engine ment for preview renders, named RS0 (which is selected by default), and RS1, the same render engine used in the final render.

Making your own preview scenes

The material preview window can actually render any MXS, this is useful to preview specific scenes or objects. When the Rightclick menu is shown, all the MXS files available in the preview folder are shown, letting you choose the desired one.

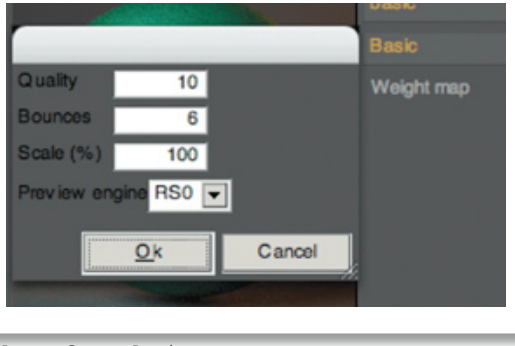
You can simply make your MXS scene as usual and make sure you have a material called "preview" in the scene applied to the object(s) you want to use for material previewing. Then save your MXS in the preview folder located in the Maxwell install folder.

MATERIAL PREVIEW



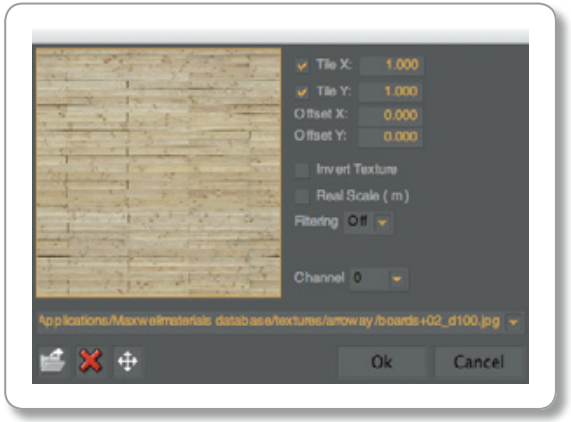
Rightclick on the preview window for Preview Options.

PREVIEW OPTIONS



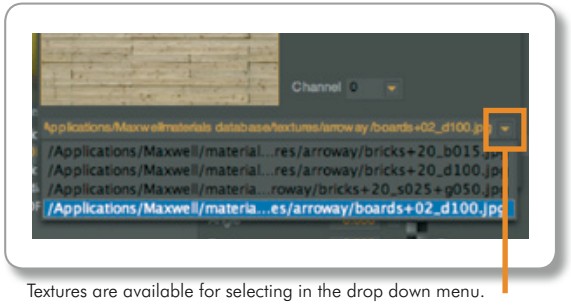
Preview Options Panel.

TEXTURE PANEL



Texture picker dialogue window.

If an object only has one UV set, but you specify in the texture picker for the texture to use UV set 1, you will get an error at rendertime, specifying the object does not have enough UVs to render the texture. Make sure you use UV set 0 for all objects that only have one UV set applied to them.



Textures are available for selecting in the drop down menu.

TEXTURE PICKER

Clicking on any texture icon will bring up the texture picker allowing you to load a texture.

Loading textures

To choose a bitmap, click on the Load Button or drag and drop it from any Explorer or desk top window into the main frame. You can drag and drop multiple textures at once. This will make the textures available for selecting in the drop down menu.

Unloading a texture

Select a previously loaded texture from the drop down menu and click Unload button to remove it from the scene. This will free up some memory used by Studio.

Tiling Options

Choose to tile the material in X,Y axis and the tiling amount.

Offset texture

Choose an offset for the X,Y axis.

Invert texture

Inverts the loaded texture. Practical for black and white textures used as weightmap on a two BSDF material. You can re-use the inverted version of the same texture on the second BSDF weight.

Real scale (m)

Checking this box will make Studio use a 1m x 1m x 1m projector for this texture, regardless of what other projector is applied to the object. This is very useful for creating reusable materials which you can simply drag and drop on any size object. For example if you want to create a material with 25cm tiles, check the Real Scale Box, and set the tiling for both X and Y axis to 0.25. Now you can drop this material on any size floor and your tiles will always be 25cm.

Filtering

Turning this option on applies filtering to the texture, which may be useful in some cases to avoid pixelisation when rendering closeups of smaller textures. Filtering is mostly useful for displacement textures, to smooth out the displaced surface, especially when using 8bit textures. It is recommended to keep this option turned off for regular textures (color, bump, weightmaps etc) to avoid blurring these textures.

Channel

Specify the UV set to be used for this texture. In Studio a “UV set” is a set of UV coordinates for an object. One object can have several UV sets. If an object only has one UV set applied to it, that UV set will be nr 0. If an object has two UV sets, they will have the numbers 0 and 1. More info on texturing workflow in Studio can be found in the TEXTURING section on page 91.

COLOUR PICKER

Maxwell colour picker is a simple and fast tool for choosing colours. The circle on the outside coloured wheel lets the user rotate the triangle inside, choosing the hue. The second circle lets you choose value and brightness within the hue selected. You can also specify the colour in HSV, RGB or XYZ coordinates with the text boxes below the chromatic graph.

DRAG AND DROP FUNCTIONALITY

The material editor has certain drag & drop features. You can drag & drop:

COLOUR CHIPS

TEXTURE ICONS

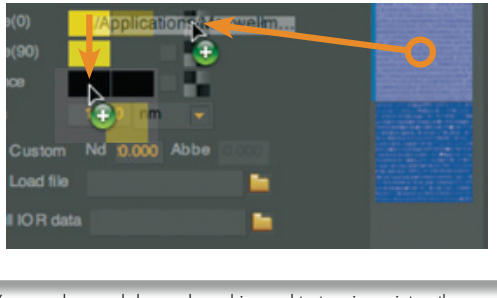
By default both texture and texture settings (tiling, offset etc) are copied. Hold Shift before starting the drag & drop to only copy the texture itself.

The drag & drop functionality also works between BSDFs – you can drag a colour chip or texture icon, from one BSDF to another. To do so, start dragging the icon over a BSDF layer icon, and the rightside of the material editor will change to show the BSDF layer properties. Now you can drop the icon in one of the appropriate slots.

COLOUR PICKER



DRAG AND DROP



You can drag and drop colour chips and texture icons into other areas.



MATERIALS COMPONENTS

BSDF PROPERTIES

The BSDF component is the base of the Maxwell material system. It contains all the parameters necessary to create many different types of materials ranging from clear glass, sandblasted glass, plastics and metals. In this first section we will go through each parameter in order, with a brief description of each. In the second section we will show different material examples and discuss the settings used.

When a BSDF is selected in the material layers, the BSDF properties are displayed in the right panel. There are two sets of controls: Material properties and Surface properties.

MATERIAL PROPERTIES:

Reflectance 0° / 90°

This is the light reflected by the material. In other words: it is the material's colour. Choose a reflectance colour by clicking the Colour Picker, or specify a texture by clicking in the texture button. You can enable or disable the texture using the check button near the texture button.

A full white reflectance (RGB 255) means that all the light that falls on the object is reflected back. Black reflectance (RGB 0) means that all the light is absorbed.

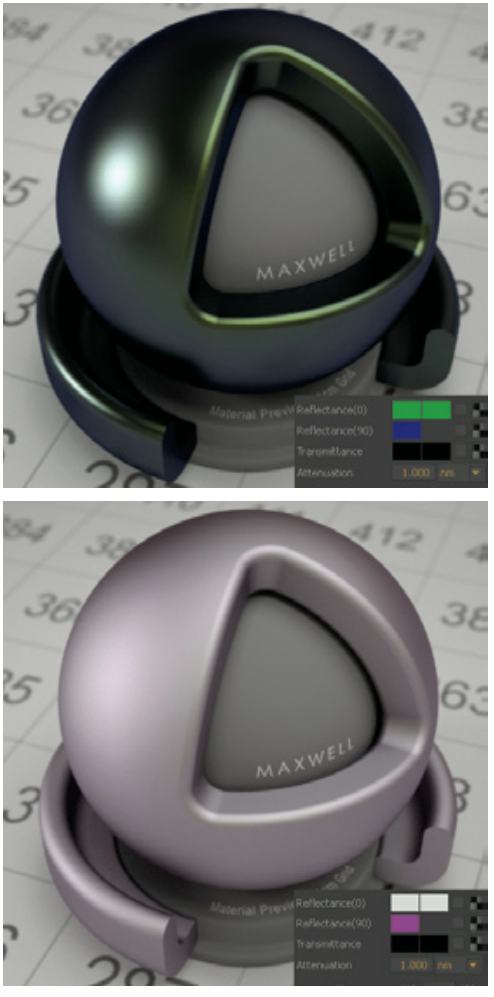
There are two reflectance colours depending on the light reflected when the object is seen at 0º degrees (frontal view) or at 90º degrees (glancing angle).

The Reflectance 0° is the objects main colour. The Reflectance 90° colour is the objects colour at glancing angles. This is useful when you have a material which reflects one colour when viewed straight on, but at sharper viewing angles reflects another colour, such as tafta, silk, velvet etc… Think of the Reflectance 90° colour as the object's "specular" reflection.

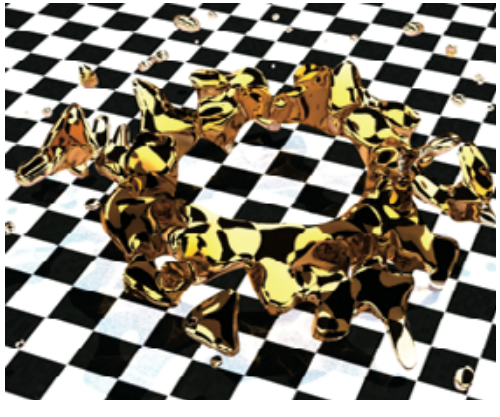
How much influence the reflectance 0° colour Vs the reflectance 90° colour has on the look of the material depends on the **Nd** setting of the BSDF, and the roughness setting. More on these two parameters in the following pages.

For most materials, reflectance 90° colour is white, however materials like metals usually have tinted reflections. Changing the reflectance 90° colour allows different reflected colours at the edges of the object like in the samples on the right. Different combinations of reflectance 0º and 90º are shown in the next figure:

DIFFERENT FRESNEL COLOURS



Avoid setting the Reflectance 0° colour very high, especially RGB 255, since that would mean all the light that falls on an object is reflected back. Such a material does not exists, some energy absorption always occurs. Maxwell internally obeys energy conservation laws, even with Reflectance 0° at 255, but setting Reflectance 0° to almost pure white will cause loss of contrast and much more noise in the renders. A white piece of paper in reality has the reflective RGB equivalent of about 220. Reflectance 90° colour however can be set as high as 255 if you need strong reflections.



Thicker areas are more attenuated.

Transmittance

For transparent materials, this parameter controls the colour of the light which passes through an object. Choose a transmittance colour by clicking the colour picker, or specify a texture by clicking in the texture button. The transmittance colour represents the colour of the light when it has reached the attenuation distance.



Note: Tansmittance must be a color other than black for transparency to appear. Setting a brighter transmittance color results in clearer transparency, however this parameter is also tied to the Attenuation Distance (see next page).

Attenuation distance

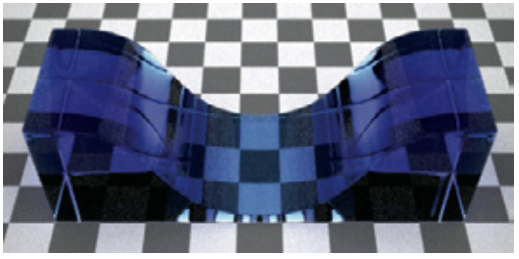
As light travels through a material, it loses energy and the attenuation distance parameter allows you to specify how far light can move through the object before losing half its energy. For example if you have a 2cm thick glass window and you set the attenuation distance to 2cm, then light shining through the glass on the other side will be half as bright.

Attenuation distance and transmittance work together. You must set transmittance higher than RGB 0 for the attenuation distance to be taken into account. Also, if your attenuation distance is very small (1nm), the object will remain opaque, since light can only travel a very small distance into the object. On the other hand, if you have a 1cm thick glass window and set attenuation distance very high (ex. 900m), and set transmittance colour to blue, the glass will not be coloured blue at all, it will be completely transparent because there was not enough distance in the 1cm thick glass to cause any attenuation and therefore reveal the transmittance colour.

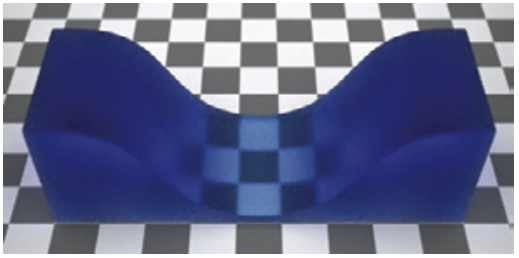
The attenuation is ruled by an exponential curve, therefore, the thicker the object, the more attenuated the light will be, as in the example on the right.

To better understand the concept of attenuation, consider sea water. When the water layer is very thin (like water in the palm of your hand) you don't see attenuation and get rather transparent water, when you have enough water thickness, you see a typical sea colour (dark or light blue-green, depending on deep or shallow waters). The transmittance colour represents the colour that you want to get approximately at the attenuation distance. Beyond this distance, the light is more and more attenuated, it loses more and more energy and the view eventually turns black.

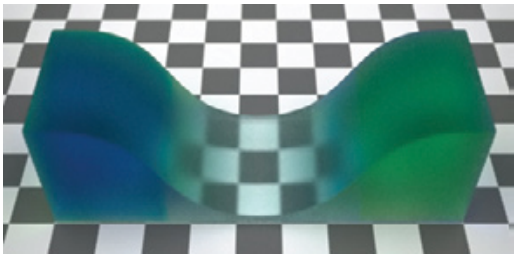
ATTENUATION DISTANCE



Blue transmittance colour/Attenuation distance (18cm) / No roughness (1).



Blue transmittance colour/Attenuation distance (18cm) / Medium roughness (40).

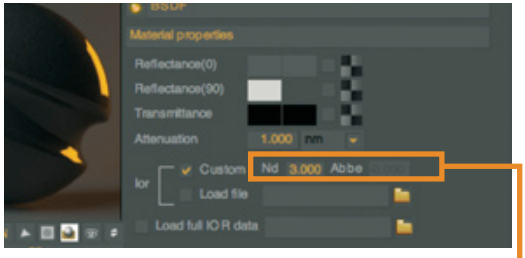


Transmittance map/Attenuation distance (18cm) / Medium roughness (40).

CUSTOM **Nd**



Nd AND ABBE INPUT FIELD



The **Nd** and Abbe input fields can be found in the Material Editor.

Custom **Nd**

Simply put **Nd,** should be regarded as the IOR (index of refraction) of the material. The name **Nd** is used because it is the common way to denote an index of refraction that has been measured at the wavelength of 583nm.

Before explaining further how **Nd** influences the look of a material, it is important to understand the "Fresnel effect". This effect states that the strength of reflections on a surface is dependant on the viewing angle. For example if you look straight on at your monitor screen, you will see very weak reflections, however if you look at the screen at an angle, the reflections will appear stronger.

The relationship between **Nd** and the fresnel effect is that with a higher **Nd** number, the surface will start to look equally reflective, no matter the viewing angle. So in effect, higher **Nd** "cancels" the Fresnel effect.

With this in mind, understand that changing the **Nd** number controls the overall reflectivity of an object. For example you can have the reflectance 90° colour set to full white, but with an **Nd** of 1, the object will not seem reflective. Setting the **Nd** to a high value like 40, and keeping the reflectance 90° to that same full white colour, will result in a mirror like surface. The following images demonstrate this:

From the images above you can see that raising the **Nd** has the result of increasing the influence of the reflectance 90° colour, while the reflectance 0° colour (in this case it was set to almost black), has less and less influence when increasing the **Nd**.

Of course the value of the Reflectance 90º colour will also affect the maximum strength of reflectance. For example you can set a high **Nd** but set the reflection 90° colour to a dark colour. The result will be a surface which is reflecting equally, no matter the viewing angle, but the reflections will appear weaker.

For opaque materials, an **Nd** of at least three is recommended if you want them to become reflective. Metals have even higher **Nd**. The **Nd** setting can go as high as 1000. For a mirror like surface it's usually enough to set the **Nd** at 100.

Note: For a lambertian material, the **Nd** has no influence on the look of the material.

For transparent materials, **Nd** also controls the amount of refraction. Seawater for example has an **Nd** of about 1.33.

Abbe

Different wavelengths of light can be refracted at slightly different angles as they pass through a material, and this is what causes *dispersion*, the effect seen when a beam of light passes through a prism and is split up into the different wavelengths of light. The name Abbe comes from the German physicist Ernst Abbe, who defined the Abbe number.

Abbe controls the amount of dispersion, the higher the Abbe number, the less dispersion will be visible in the render. An Abbe number higher than 60-70 will render as if dispersion was not activated.

Load file

This option allows us to include an .r2 file to have a maximum control of the fresnel effect over the surface. For most materials, the falloff between the 0° color and the 90° is controlled by the ND and roughness parameters – a high ND number means more of the 90° color will be visible when using a low roughness value, but as you increase the roughness, the 90° color will start to disappear until at roughness 99 (or lambert), the 90° color won't be visible at all.

This is the normal behavior but there may be special cases where you would like to control the influence of roughness and still keep the 90° visible at high roughness. Examples would be car paints that quickly change their color to another color based on viewing angle, or velvet which has a high roughness but has a bright "sheen" which would not be possible to create without an .r2 file.

The .r2 file is a simple text file containing two parameters. You can make your own .r2 files with a text editor and writing for example: 35 0. Save it with an .r2 extension and load it in the "Load file" of the IOR section of the material editor (NOT the Load full ior section). The first parameter can be set between 0-90 and controls the falloff angle between the 0° and 90° colors. The second parameter can be set between 0-100 and controls how much roughness should influence the effect. For instance if you write 45 0, the 90° color will start appearing when the viewing angle increases more than 45° and roughness will have no influence on the effect:

Other .r2 file examples:

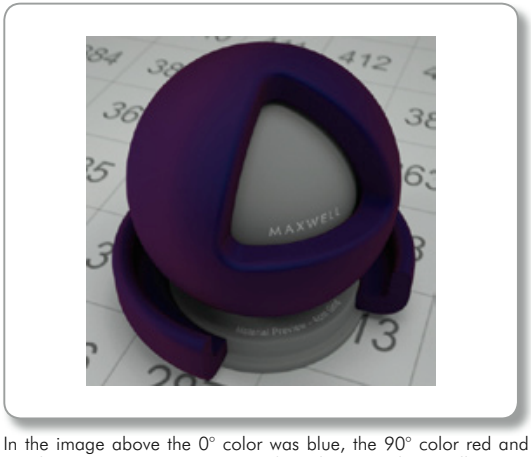
15 0 < the 90° color will quickly become visible, right after the viewing angle is 15° and more. Roughness will not influence the effect. 70 50 < the 90° color would become visible only at a large viewing angle, making it appear almost only at the edges of the object. Increasing the roughness would make this effect less visible, but it would still show up. 85 100 < the 90° color would be visible only at the very edges of the object, and increasing roughness until 99 would make the effect virtually disappear.



Dispersion will raise the render time; therefore it is disabled by default. In order to enable dispersion, click on this button.



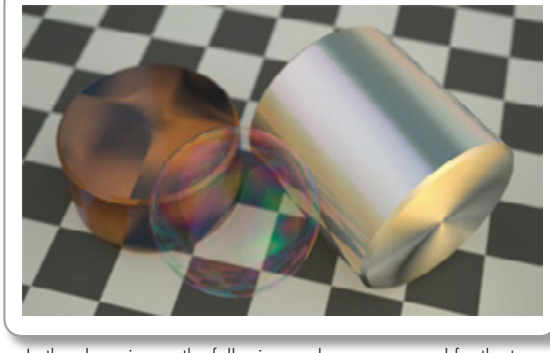
Spectral dispersion.



In the image above the 0° color was blue, the 90° color red and the roughness set to 99. You can see how the 90° color is still very visible even with roughness set to almost lambert and it starts appearing once the viewing angle increases to approximately 45°.

THE COLOUR CHIPS:





In the above image the following angle map was used for the top of the cylinder (no map was used for the sides of the cylinder).



Load full IOR data

As an alternative to the Reflectance, **Nd** and Abbe values, you can use an .ior file which provides Maxwell with the exact index or refraction for each wavelength.

"Complex IOR" (a.k.a. Full IOR) data is collected from precise measurements in laboratories and describe the optical properties of a material to the highest degree of accuracy. These materials have the advantage of being extremely realistic, with two drawbacks:

The use of complex IOR data means Maxwell has a lot more math to do. Complex IOR computations require evaluation of more mathematical functions and they are dependent on view angle and on spectral wavelength as well as involving the computation of full dispersion (which by itself introduces a performance hit; taking longer to resolve image noise). This method does not allow many optimisations without sacrificing the intended physical accuracy.

However surface properties such as roughness, anisotropy, bump can still be changed when using IOR files. Of course a BSDF with an IOR file loaded can still be mixed with other "regular" BSDFs to create many interesting materials.

The Colour Chips

Reflectance and transmittance influence each other. For example if more light is reflected from the surface of the object, then less light will be transmitted through it. Therefore, the reflectance and transmittance colours are corrected according to this. You can see a second colour square showing the corrected colour. Hovering the mouse over the squares will show a tooltip with the numerical RGB values.

SURFACE PROPERTIES:

Roughness

The roughness of the surface ranges from 0 (perfectly smooth surface) to 99 (almost pure diffuse). The Lambertian checkbox will use a perfect diffuse model (like 100% roughness). It is important to remember that if you want to have very smooth, mirror like surfaces, or clear glass, the roughness should be low (ex. 0–10).

You can also set a black and white texture to control the roughness. Brighter values in the texture means higher roughness (a more diffuse surface). When using a texture the roughness number is still applicable, but with a texture applied, it controls the maximum roughness allowed. For example, if you use a black and white checkermap as a roughness texture, and you set the roughness to 30, then the white parts of the texture will result in 30 roughness, while the black parts will represent 0 roughness. If you now change the roughness to 70, the white parts of the texture will result in 70 roughness and the black areas will still represent 0 roughness.

Anisotropy

Specify anisotropy strength (0 for isotropic surfaces – 100 for full anisotropy). You can also set a texture to control the anisotropy strength.

Angle

Specify the anisotropy angle (the main direction of reflected light). You can also set a texture to control the anisotropy angle.

Bump and Normal Mapping

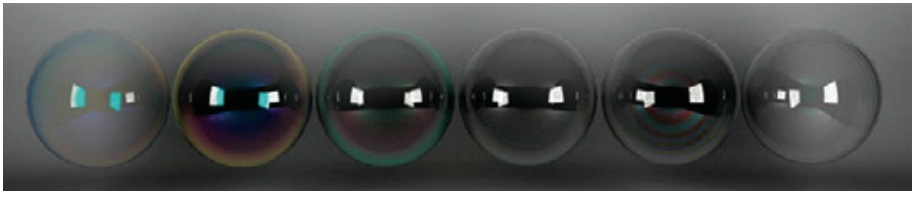
Specify a bump texture and the bump strength. There is an additional option to specify a normal map as a bump texture. For normal maps, you have the choice of flipping the X, Y, Z in the texture picker, depending on how the normal map was created. Bump is a very sensible parameter and standard values will be around 1 – 15.

COATING PROPERTIES

Coatings are very thin layers that are placed “on top” of the BSDF. Because coatings are so thin, they produce an effect called “thin film interference”, which breaks up the light and can cause a rainbow like pattern. Think for example about spilling a drop of oil on a surface of water, the very thin layer of oil will create interference patterns. The coatings can also be used to create rough materials with a clear coating, for example, a glossy white plastic can be made of a diffuse BSDF plus a coating.

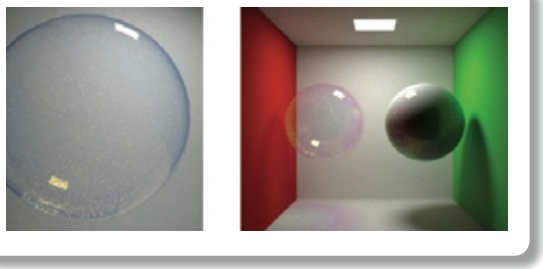
The main property of the coating is its thickness. The thickness is specified in nanometers (nm). The thickness can be specified by a numerical value or through a weight map. To avoid interference colouring, you have to use higher thickness values such as 1 mm (1000000 nm).

Only one coating is allowed per BSDF. You can make a material having just a coating and no BSDF. To do this, add the coating normally (Rightclick on the BSDF or the BSDF Folder > Add Coating), and then simply select the BSDF and delete it by pressing the Del Key on your keyboard or Rightclicking and choosing Remove Layer.



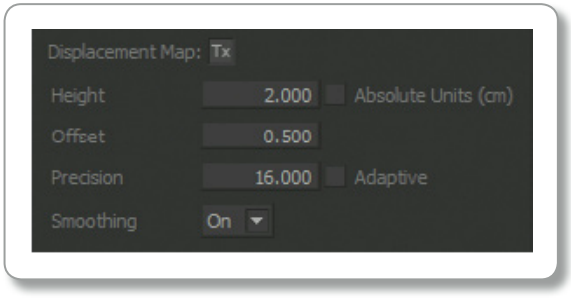
Coatings with different thickness.

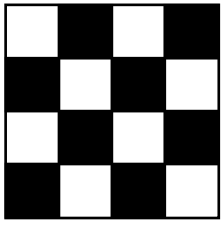
COMPLEX IOR FILES



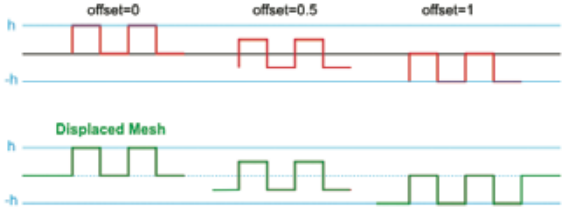
Water bubble using the h2O.ior file Coating bubble and coating applied to diffuse sphere.

MAXWELL DISPLACEMENT:





Dispalcement Map



Base Mesh Surface

Introduction

The displacement feature simulates real geometry at render time as if it was actually modelled. This feature is very useful for adding fine detail to a mesh which would otherwise be difficult or impossible to actually model. Displacement uses a texture to define the geometric detail. Unlike many other displacement solutions which pre-tessellate the geometry causing an increase in memory usage at render time, many times in the order of hundreds of megabytes for large detailed displacement, Maxwell's unique displacement method allows you to create virtually unlimited detail while using very little extra memory.



The Parameters

To use displacement, you need an object with UVs, and a displacement texture. The texture used is similar to a usual greyscale bump map – you have different shades of grey to describe elevation levels. For example lighter greys will raise the geometry, darker greys will create cavities. The main displacement parameters control the surface precision and height of the displacement.

Displacement Map

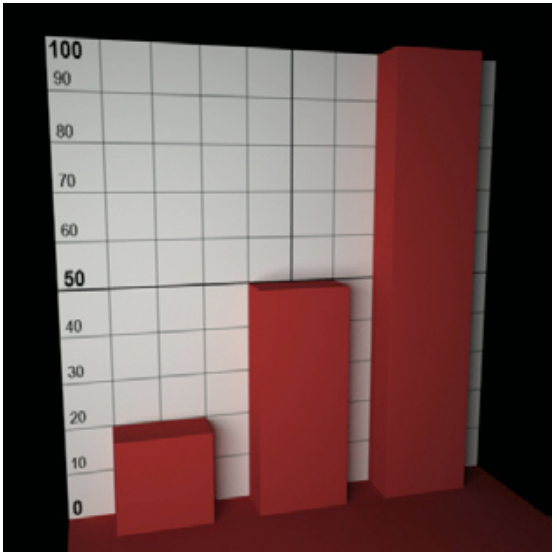
You must first load a displacement texture to access the displacement parameters. Maxwell can use 8, 16 or 32-bit greyscale displacement maps. It is recommended to use at least 16-bit displacement image as 8-bit images may not contain enough grey levels (only 256) to make a smooth displacement. You may see a stair stepping effect if using 8-bit maps. 8-bit maps may be enough for displacements that don't require smooth transitions between grey levels, and additionally Maxwell's texture interpolation helps to render even 8-bit images smoothly.

Offset

This parameter allows you to specify which grey level in the texture should represent zero displacement. It is important that you set this parameter correctly based on what type of displacement map you use. For example some displacement maps may use 50% grey to specify zero displacement (darker shades than 50% in the texture will create cavities, lighter than 50% will raise the geometry). In this case, you have to set the Offset parameter to 0.5 to get a proper displacement. If your displacement map uses black to represent zero displacement, set Offset to 0.

Height

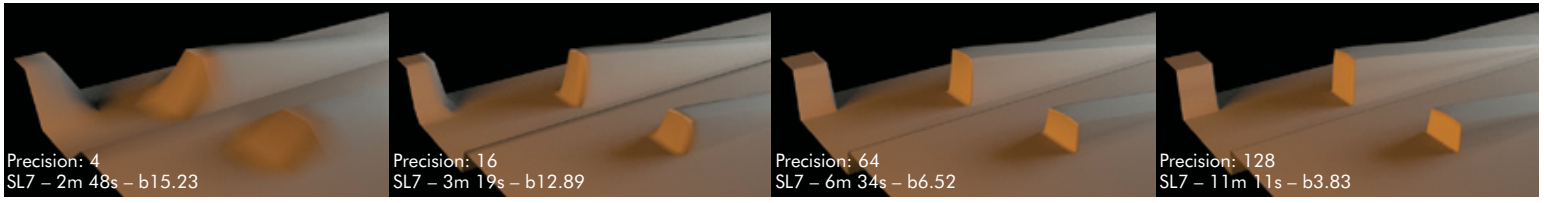
This parameter sets the maximum allowed displacement distance. It tells the engine how much real geometric height you want to displace on your base mesh. This value needs to be greater/less than zero for displacement to appear. The white of your texture will be raised to the height value you set. Displacement height can be set to use either relative or absolute height: - by having the “Adaptive Units” option unchecked the given value will represent the desired height as n% of the longest edge of the associated object’s bounding box. For example you have a car 300 x 150 x 110 cm and you set height as 1, this means the peak displacement will be 1% of 300 (the longest edge of the bounding box) which is 3 cm to be observed as real length in render output. Using relative height is useful when you wish to preserve the same displacement height if you scale the object. - checking “Absolute Units” allows you to set the Height in centimeters and it will always displace to this given value regardless of object dimensions.



The image shows grey values 51 (20% grey), 127 (50% grey) and 255 (white) in order.

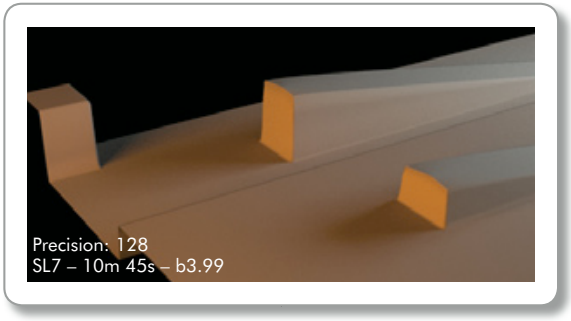
Precision

Precision defines surface accuracy, ability and response to detail independent of texture resolution. This means two things: - specifying a low precision value and using a high resolution texture (lots of detail), will not show more detail in the render than what is allowed by the precision value. - specifying a high precision value but using a low resolution texture will reach the limit of the pixel detail of the texture and will not result in a more detailed displacement. The displacement will have reached the detail level of the texture. This is important to understand because you can optimize the displacement by starting with a high resolution texture and lower precision value, and keep raising the precision value until the detail in the displacement is satisfactory. Example of how surface detail and render time are affected by increasing precision for the same texture:



Example of how surface detail and render time are affected by increasing precision for the same texture:

We can see in this case that going beyond precision 128 wouldn’t add more detail but it would keep increasing render time. So it’s important to avoid unnecessarily excessive precision values.



In the example above, the same texture was used and adaptive mode turned on. We can see that the maximum detail this texture can provide has a similar render time of using a 128 precision value. But perhaps the user would have mistakenly set the precision value to 200–300, resulting in increased render time, not realizing the texture couldn't provide any more detail. So in cases where you want to get the most possible detail out of the texture, Adaptive mode can be useful. In most cases however it is recommended that you fine tune the precision value and leave Adaptive mode off as this allows you to optimize the render time while still having an acceptable level of detail.

Adaptive

The adaptive option locks the precision value to the given texture detail (at half pixel accuracy) which has the advantage of always creating the most detailed displacement that a given texture can provide. The user doesn't have to guess what the maximum precision value should be for that texture, or worry about exceeding it (which would increase render time but not increase the detail).

However this mode needs to be used with care, because using a very large resolution texture to represent a simple detail will result in unnecessarily long render times.

Smoothing

Similar to the objects smoothing angle setting, this parameter controls whether the displaced surface should render smoothly (continuous shading) or render facetted. It is generally suggested you leave this setting to On, unless you aim to render very sharp detailed displacements. Please note that the objects smoothing angle will still override the smoothing used for the objects base mesh faces, so if the objects smoothing angle is set to Flat (making the object render facetted), and the Smoothing parameter is set to On in displacement parameters, a smooth displacement surface will be rendered over a facetted base mesh surface.

Important Tips:

Impact on Render Time

The render times can vary greatly and it depends mainly on 3 factors: - The base mesh vs precision value (see below for details) - The height of displacement (more height will increase render time) - How much of the rendered image contains displaced objects. For example a common usage of displacement may be a brick wall seen from far away which takes up 30-40% of the rendered image, in which case low height and precision values can be used, and render time impact will be minimal, vs a close up render of a displacement object taking up the whole image space and high precision values need to be used.

Base Mesh vs. Precision

The more polygons you have in your base mesh, the less precision you will need to render the same amount of displacement detail. Thus, using less precision will always render faster. For example, if you're planning to render displacement over a plane, model your initial plane using more than 2 triangles. A typical 4 x 4 subdivision will remarkably speed it up. Objects made of evenly distributed polygons are preferred for better quality. Otherwise you will need to increase the precision to compensate the surface fidelity and it will add to your render time.

Rendering Sharp Details

For rendering sharp details, consider turning off texture filtering. It will help you render high contrast areas in your texture sharper. If you're using a moderate precision value, displacement will tend to smooth the rendered detail. In this case, you should also turn off Smoothing under displacement options for rendering the details sharper. Keep in mind that turning off texture interpolation will tend to reveal stair stepping effect if using 8-bit maps with smooth gradients in them.

Object Smoothing Angle

To avoid any possible artifacts/gaps in the displacement on objects which contain polygons connected at sharp angles, make sure you set an object smoothing angle that exceeds the max polygon angle the object contains. (e.g. for a cube, it should be 90 or greater)

SUBSURFACE SCATTERING PROPERTIES

Subsurface scattering (SSS) properties can be added to each BSDF. Transmittance must be set to any value other than black for SSS to have an influence on the material. Higher transmittance values will result in brighter and more transparent subsurface effect. When adding an SSS component to the BSDF, the attenuation distance of the BSDF is not taken into account, and it is the absorption unit of the SSS component that will control the amount of absorption/attenuation of light inside the material. An **Nd** of about 2–3 should be used for subscattering effects. Lower **Nd** can be used if a very clear material is desired.

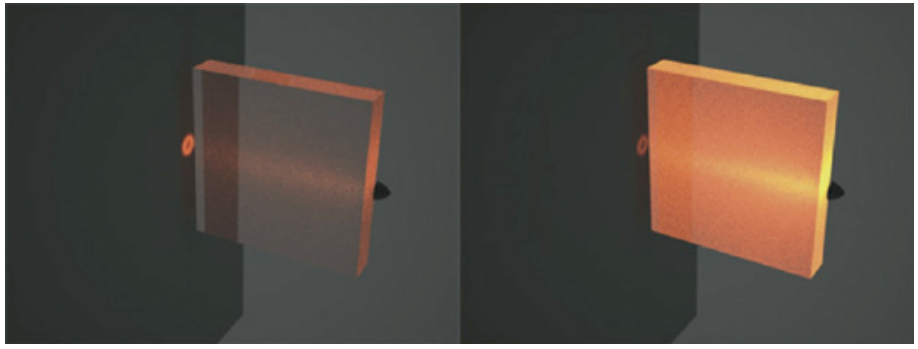
Absorption

Defines the amount of light to be absorbed through the object surface. When raised, the surface will absorb light quicker.

Scattering

Defines the amount of light to be scattered through the surface. When increased, it has the effect of increasing the spreading of light in the surface.

BOTH IMAGES HAVE AN ABSORPTION RATE SET TO 0.1.



THE LEFT IMAGE HAS A SCATTERING SETTING OF 0.1.

THE RIGHT IMAGE HAS SCATTERING SET TO 0.5.

SCATTERING

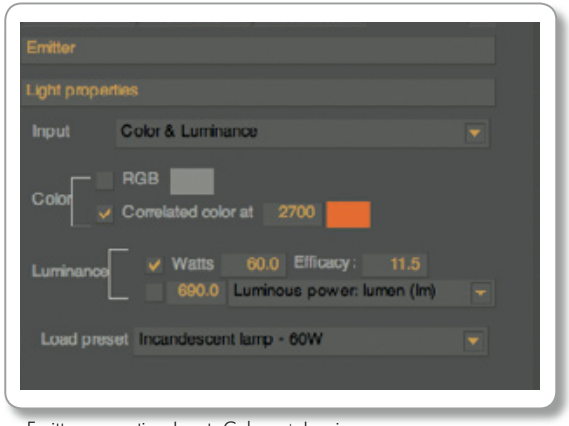


For the above images, transmittance was set at RGB: 200,100,100, or in HSV: 0, 150, 200. The left image has the default SSS settings of absorption 0.5 and scatter 0.5. The right image has absorption set to 30.

Increasing the transmittance and keeping the absorption high can create materials that make the SSS effect more sensitive to thickness variation in the model. For example:



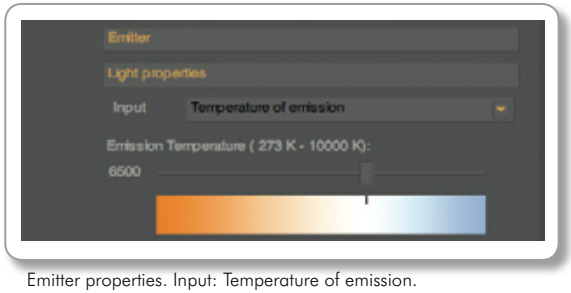
Both images have absorption set to 30. Left image has a transmittance value (HSV) of 200, right image has a value of 250. You can see the subscattering seems to be more "localized" in the right image, we get a bigger distinction between areas that show subscattering and areas that do not. For instance, the thinner ring lets the subscattering peak through, and the scattering is also brighter on the upper left part of the sphere because that is the direction the light is coming from.



Emitter properties. Input: Colour + Luminance.

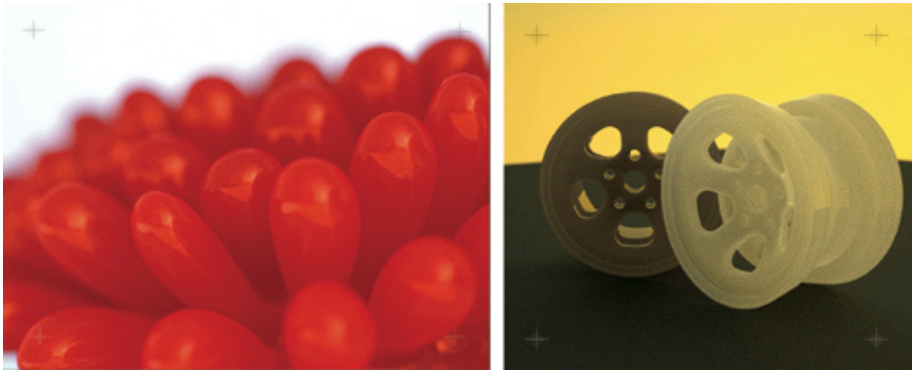
In most situations, an emitter material should be applied to a single polygon plane. Try to keep the geometry of the emitter as low as possible as it takes more time to remove noise if the emitter is made of complex geometry.

EMITTER PROPERTIES



Emitter properties. Input: Temperature of emission.

The effect of different scattering settings can be difficult to see, it depends largely on the size of the object. In small objects even a low scattering value will have the effect of scattering much of the light.



Subsurface scattering effects.

EMITTER PROPERTIES

The emitter material can be applied to a BSDF material, or it can be a material of its own. Emitter materials can be applied to any object in Maxwell. To create an emitter-only material, create an emitter type material. To add an emitter component to a normal material, rightclick on any of the BSDFs or BSDF folders and choose Add Emitter. Only one emitter component can be added to a material.

Input

This is the most important parameter as it defines which type of emission will be used emission. There are several possibilities:

- Colour & Luminance.
- Temperature of emission.
- Image Emission.
- Load emission data file.

COLOUR AND LUMINANCE:

Colour

This parameter refers to the colour of the light emitted. There are two ways in which you can specify the colour.

RGB

(Red, Green and Blue). Clicking on the coloured square allows the user to choose a colour in the Maxwell colour picker.

Correlated colour at

Lets you choose the colour that would correspond to an emission in Kelvin degrees. Please note that choosing this option will not make any changes on intensity, just colour. Low Kelvin temperatures are reddish coloured, 6,500K is considered white, higher values will produce bluish light.

Luminance

Specifies the intensity of the light. There are several ways the user can choose.

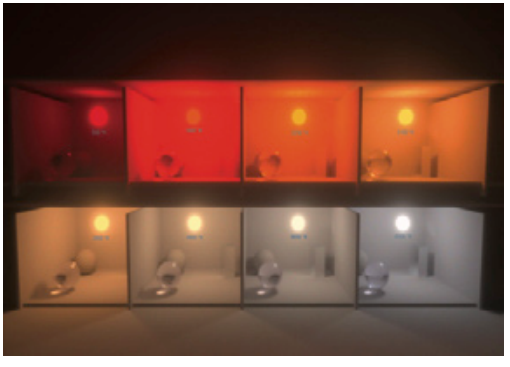
Watts and Efficacy

Allows you to specify how much electricity a lightsource consumes (Watts) and how efficiently it converts that electricity into visible light (Efficacy). The efficacy number specifies how many lumens are emitted per watt. For example a common 40W incandescent bulb will have a pretty low efficacy of 12.6 lumens/watt. This data can usually be found on the manufacturers website. However a more efficient energy saving bulb which is also rated at 40W will have an efficacy of perhaps 17.3 lumens/watt so for the same amount of energy consumed, it will emit more light. The watts/efficacy way of specifying the emitters intensity is useful if you want to mimic common lightsources, when the manufacturer provides the watt rating and the efficacy rating.

Luminous power

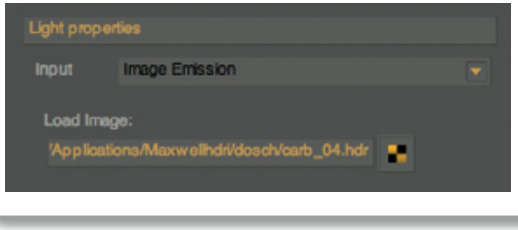
Lumen (lm). Lumens is the SI (International System of Units) unit for luminous flux. It is a common way to specify how much light is emitted and light manufacturers usually supply this data.

TEMPERATURE OF EMISSION



Emitters at different °K temperatures.

MXI TEXTURE





Illuminance

Lux (lum/m^2). Lux is the unit for specifying illuminance. It is defined as one lumen per square meter. This is a useful setting when you want to increase or decrease the size of your emitter, and have it emit more or less light with the changed size of the emitter. With the previous setting (luminous power), if you scale up your emitter for example, the amount of light emitted will be the same, giving the impression that the overall light is dimmer. But in fact the same amount of light is emitted, just over a larger area thus giving the impression that the emitter is weaker.

Luminous Intensity

Candela (cd). Candela is considered the base SI unit for luminous intensity (the power of light emitted in a certain direction).

Luminance nit (cd/m ^ 2)

One “Nit” is one candela per square meter.

Load Preset

Maxwell Render™ provides some emitter presets of standard type lightsources.

TEMPERATURE OF EMISSION:

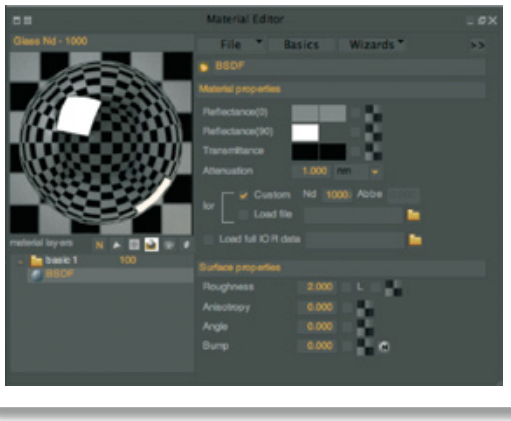
A temperature in Kelvin degrees can be chosen. This will affect not only the colour but also the intensity of the emission. A higher temperature will make the emission more intense. The colour will change from RED (low temperature) to ORANGE → YELLOWISH → WHITE → BLUE.

IMAGE EMISSION:

This emission option allows you to texture an emitter with an MXI/HDR/EXR. The intensity of an MXI/HDR/EXR map can be adjusted using MXCL. MXCL can also be used for converting regular bitmaps or an HDR/EXR map into an MXI map. For more info about using MXCL for adjusting HDR/EXR maps or creating MXI maps, see the section on MXCL on page 102.

MIRROR-LIKE MATERIAL





The **Nd** was set to a high value here (1000) since we wanted a totally reflective surface. The roughness was set very low in order to have sharp reflections. The Reflectance 90° colour was set to full white to have strong reflections. The Reflectance 0° colour was left at default 128 grey (which such a high **Nd** the Reflectance 0° will have almost no influence on the look of the material).



MATERIALS TIPS

In this section we will provide practical examples and tips to help you better understand the parameters discussed above. We strongly encourage you to experiment with the material system, in the beginning with simple one BSDF materials.

COMMON GLASS

Nd was set to 1.51 which is a reasonable **Nd** for glass. Following the relationship of **Nd** and the Fresnel effect, we can use the Fresnel formulas to calculate that the reflectance of such a material (with an **Nd** of 1.51) near incidence angle (looking straight on at the material) would be about 4%, which translates into RGB at about 11. This is the value used for the refl 0° colour. Of course you don't have to calculate this value exactly, just know that for materials with the **Nd** around 1.5, the refl 0° colour has a value of around 10–20. Of course you can always raise it if you want shinier looking glass, but it's always good to know how this kind of material would behave in reality, if it's realism you're looking for. Most glass materials have an **Nd** around 1.5.

The reflectance 90° colour can be left at 255 since this glass will not tint the specular reflections, and it will also reflect almost light at this viewing angle.

Transmittance was set to R:227 G:230 B:230 to give it a slight green/blue tint. The transmittance was set a little low here to mimic a low grade glass with imperfections which give it a slight colour, and it is not extremely transparent like high grade optical glass types.

Attenuation distance was set to 3cm which is a good value to use for common low grade glass. Remember from the material section that attenuation distance is the distance the light travels through a material before losing half its energy. This means that for a glass panel 1.5cm thick for example, the light passing through it and reaching the other side would have lost a quarter of its strength. For high grade glass the attenuation distance can be much larger, even more than five meters. Setting a higher attenuation distance means you'll get clearer glass, since light can easier pass through it.

Remember that attenuation distance and transmittance are parameters that work together. For example you can have a low value transmittance (ex. 220, 210, 200), and starting with an attenuation distance of 3cm you will get a pretty heavily tinted glass. Raising the attenuation distance now will cause the glass to clear up. If instead you raise the transmittance values but keep attenuation distance at 3cm, the glass will become less colour tinted but will still be relatively dark.

Roughness was set to 0 for a perfectly smooth glass.

PLASTIC

A plastic material can be made by using a two BSDF material. It's best to set the blending mode to Additive in the case of plastics (see Additive Vs Normal mode on page 35 for more).

The first BSDF is the plastics base colour. The refl 0° colour was set to 210, 210, 65. The refl 90° and **Nd** number does not matter and can be left as default since the material has Lambert checked (100% diffuse surface).

The second BSDF will be the shiny "topcoat" of the plastic. The refl 0° colour was left at default but you can lower or raise it to have an overall shinier plastic. The refl 90° colour was also left at default since we want the plastic to be very shiny at the edges, and no tinting of the reflections.

Nd was set at 3 which is a good value for plastics.

The blending weight of the second BSDF was set to 30 to make the shiny BSDF have less influence on the final material. This makes a more realistic plastic. Try to avoid having layers all weighted at 100 when using Additive mode. This blending mode can produce unrealistically reflective materials since their values are added together and not normalized in the same way as in Normal blending mode.

To make the plastic more or less shiny, there are two possible approaches:

1. You can lower the refl 90° colour, and/or lower the **Nd** of the second BSDF to make it less shiny. To make the plastic shinier, since the refl 90° is already at max you can raise the **Nd**.
2. You can increase the blending weight of second BSDF which will make this BSDF have more influence on the final look of ~~the~~ material. Avoid increasing it too much beyond 30 in Additive mode. (SEE ABOVE).

SHINY WOODEN FLOOR

The plastic material approach can be almost entirely copied for this particular material, we only need to add a diffuse texture to the first BSDF, and a bump map.

The diffuse texture is added to the first BSDF (the lambert one), in the refl 0° slot.

The bumpmap is also added to this BSDF, strength set at two. Experiment with the bump value and remember the bump parameter is pretty sensitive. Very high values (such as 40), can produce unrealistic effects and longer render times.

The second BSDF can be left untouched except you can increase the roughness value to avoid perfectly smooth reflections. For this image the rougness was set to 15. If the floor is too reflective, the quickest way to change the amount of reflection is to lower this BSDFs weight value.

PLASTIC & SHINY WOODEN FLOOR



WHEN TO USE REGULAR BSDF OR IOR FILES?

Suppose you work in jewellery and want to render gold (and only gold in its pure form) and you don't mind waiting longer for a high resolution image as long as the result is physically accurate in the most precise way possible; capturing the subtle effects of light and the unexpected shifts in colour as it would if a real gold object was present. In this situation the use of a complex IOR material is best for you.

On the other hand, suppose you're working on a two-minute animation of a gold robot for a TV production. In this case you need speed and flexibility. For instance, you might want the gold to look a bit redder and you might want it to reflect some blue light in areas. In this case the extreme accuracy of an .ior file is not needed. In this case you can use a regular BSDF material and adjust the parameters until you get something that ressembles gold in many respects. Your custom-made gold is still following the physical laws of light for accuracy, while still being entirely customizable and production-friendly.

The use of BSDF materials will also speed up rendering time. The biggest speed gain for BSDF Vs .IOR files will be seen for glass type .IOR files, metal .IOR files will not slow down the render by much.

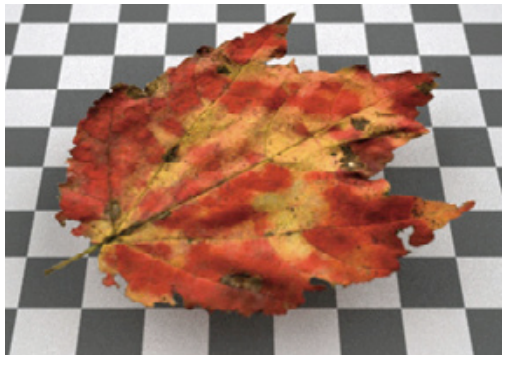
CLIPMAPS USING TRANSMITTANCE MAPPING

The transmittance map can be useful to simulate clipmaps. Clipmaps are defined by a black and white bitmap used as a transmittance map.

Remember that the transmittance colour is defined as the colour obtained approximately at the attenuation distance. However, there are two exceptions:

If the transmittance colour is pure black (RGB 0, 0, 0) the object is considered opaque.

If the transmittance colour is pure white (RGB 255, 255, 255) the object is considered transparent.

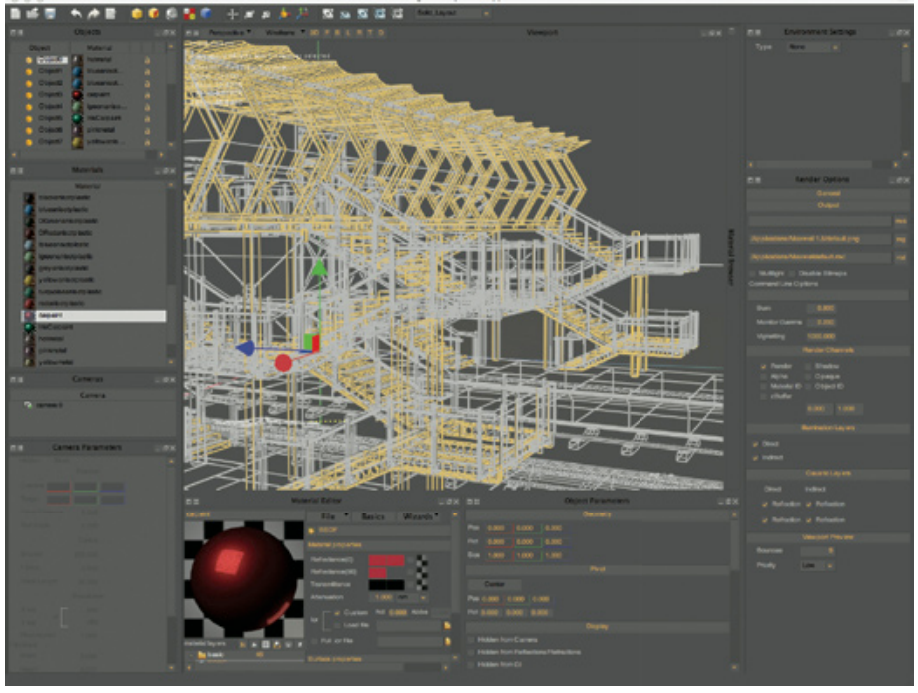


CLIPMAP EXAMPLE

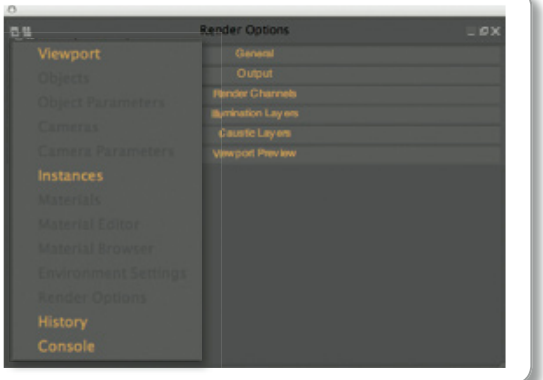
MAXWELL STUDIO (MXST): INTRODUCTION

Maxwell Studio is a full, standalone application to render scenes and objects imported from other 3D applications. Maxwell Studio provides the following functionality:

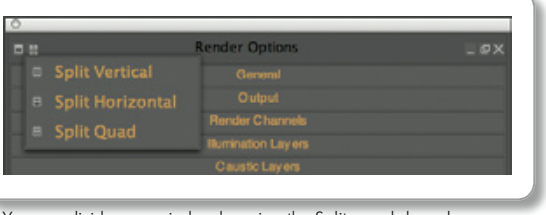
- Import object files.
- Set attributes of objects (position, rotation, scale, pivot, smoothing, normals, etc).
- Apply textures using UV projectors.
- Apply physical materials and lights.
- Visualise the 3D scene in graphical viewports.
- Create multiple cameras and adjust their position and parameters.
- Set sky options.
- Fully customisable layout with the ability to save layouts.
- Libraries of preset scenes, materials and layouts.



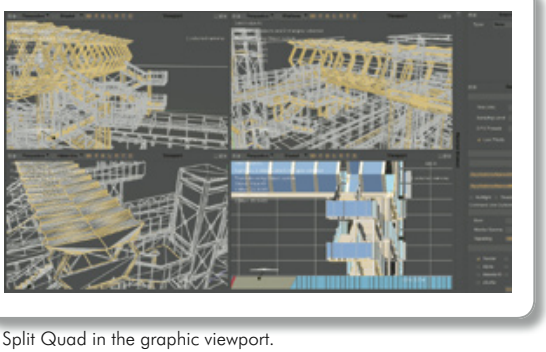




Displaying any panels is easy. Click on the Upper right icon to access the list.



You can divide your window by using the Split panel drop down menu.



Split Quad in the graphic viewport.

CUSTOMIZING THE LAYOUT

Maxwell Studio's layout is fully customisable. Each window can display any of the available built-in panels by clicking in the upper left icon and choosing the appropriate panel. If a panel is already open and it's unique, its name will be greyed out.

Moving panels

Panels can be moved from their place to another by clicking their title bar and simply drag and drop in another area of the layout. This makes it very fast and easy to configure a layout.

Undocking panels

Panels can be undocked from the main layout by clicking the icon in the title bar. Once a panel is undocked, drag and dropping it in an area of the layout.

Opening a new floating panel

From the main menu option, click "Window" and choose which panel you wish to open as a floating panel. Dock it by clicking its title bar and drag drop it into an area of the layout.

Removing a panel

Panels can be removed by clicking the in the title bar. The layout always reconfigures automatically, expanding or stretching the rest of panels.

Splitting a panel

Panels can split vertically and horizontally, allowing new panels to be added to the layout. This is the usual way to build a new layout, by splitting the existing panels and adding new ones. The split quad option creates four new panels and replaces the original.

Collapsing a panel

Panels can quickly be collapsed/expanded by clicking the ▁ button in the upper right corner of a panel. A collapsed panel shows a light grey button when collapsed. Click it to expand the panel. Collapsing panels is very useful to quickly make more space for other panels without having to rearrange or close the panel.

Saving a layout

Once you are happy with your custom layout, save it from the main menu Window > Save Layout. The file will be saved as an .stlay file.

Opening a layout

From the main menu choose Window > Load Layout and navigate to a folder containing the .stlay file.

Quick switching between layouts

You can quickly switch between different layouts by using the drop-down list located in the top row of buttons.

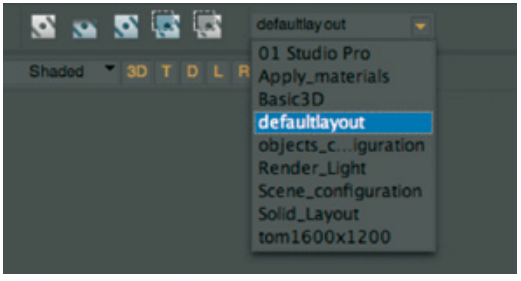
You can also switch layouts from Window > Layout and choosing from the list of available layouts. Make sure to save your custom layouts in the Maxwell/layouts directory on your computer so that they appear in the list. You need to restart Studio for a newly saved layout to appear in the list.

Setting a custom layout as default

Saving any layout as "defaultlayout.stlay" will make it the default layout when Studio is launched. It is recommended first that you rename the "defaultlayout.stlay" file in the Maxwell folder if you later wish to reload the original default layout.

A set of layouts are available under the layout folder on the installation. These layouts are focused on different tasks like mapping, rendering or editing.

QUICK SWITCHING BETWEEN LAYOUTS

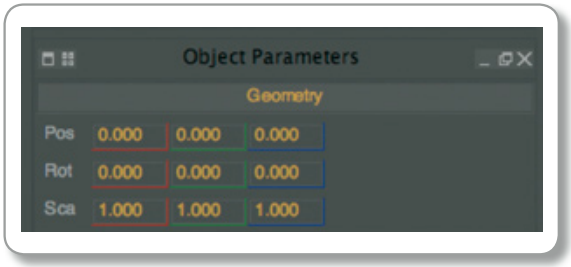


You can always access different layouts quickly form the Layout menu.



"Background" section collapsed and then expanded.

NUMERICAL INPUTS



You can change the numerical values by either typing new numbers or pressing the middle mouse button and dragging.

Panel Types

Maxwell Studio provides different panels for different functions. The panels can be accessed by switching an existing panel or using the menu command Window to open a floating panel.

- 3D VIEWPORT _____ Perspective or camera viewport.
- 2D VIEWPORT _____ Orthographic viewport.
- MATERIAL LIST _____ List of materials available in the scene.
- MATERIAL EDITOR _____ Advanced editing of the selected material.
- MATERIAL BROWSER _____ Browse material libraries.
- ENVIRONMENT SETTINGS _____ Physical sky / sky dome / HDR lighting options.
- RENDER OPTIONS _____ General rendering options.
- OBJECT LIST _____ List of all objects and groups of objects in the scene.
- OBJECT PARAMETERS _____ Parameters of the selected objects.
- CAMERA LIST _____ List of cameras in the scene.
- CAMERA PARAMETERS _____ Parameters of the selected camera.
- CONSOLE _____ Console messages.
- HISTORY _____ List of changes made in the scene.
- INSTANCES _____ List of instances for the selected object.

More detailed information about using each panel type can be found in the MAXWELL STUDIO: PANEL TYPES section on page 71.

Most of the panels are divided into subsections to form a more efficient display of information. Click on the section name to expand that section and click it again to collapse the section.

The numerical inputs can be edited by typing new numbers or pressing the middle mouse button and dragging up and down to scroll the number. Press CTRL while using MMB to scroll faster through the numbers. Alternatively you can use the scroll wheel of the mouse for quicker number scrolling.

When right clicking on a numerical input, numeric precision can be chosen for that particular parameter.

USING THE VIEWPORTS AND CAMERAS

The viewports in Studio are OpenGL® based and display all the scene items (objects, cameras, etc). You can create as many viewports in a layout as needed. Any panel can be switched to display a 3D/2D viewport.

NAVIGATION:

These are the basic functions to navigate in the graphical viewports:

- ALT + LMB = ROTATE CAMERA AROUND THE TARGET ORIGIN
- ALT + MMB = PAN CAMERA
- ALT + RMB = ZOOM IN/OUT CAMERA

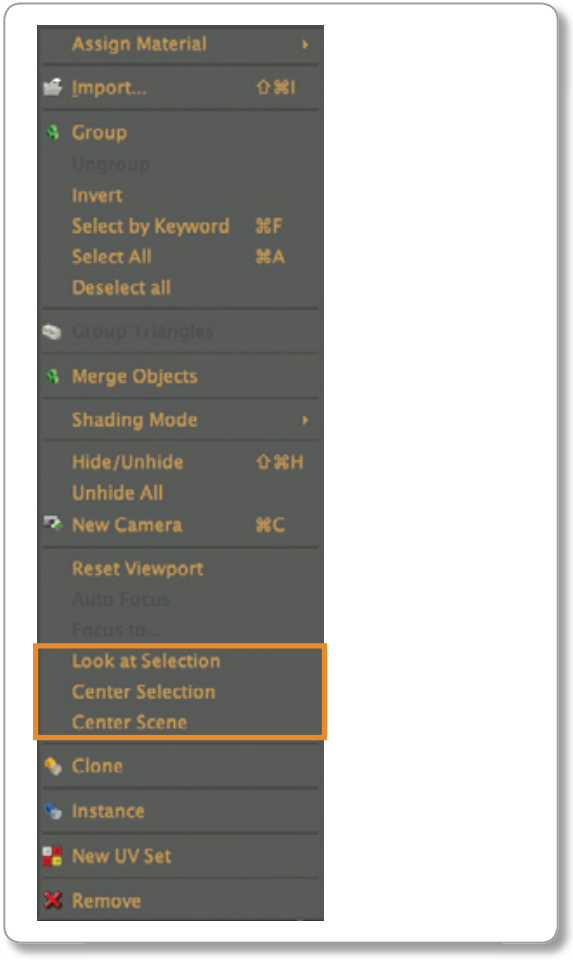
- ALT + CTRL + LMB = “slow-mode” – slowly rotate camera around the target origin. Up/Down arrows on keyboard can be used to change how slowly the camera should move in this mode. You can repeatedly press the Down or Up arrows to adjust, then use. ALT + CTRL + left mouse button.
- ALT + CTRL + MMB = “slow-mode” – slowly pan camera.
- ALT + CTRL + RMB = “slow-mode” – slowly zoom in/out camera.

- ALT + SHIFT + LMB = ROTATE CAMERA TARGET AROUND THE CAMERA ORIGIN.
- ALT + SHIFT + RMB = DISPLACE CAMERA ORIGIN ALONG THE LOOK-AT DIRECTION. This also moves the camera’s focal point (camera target), along with the camera.
- ALT + SHIFT + MMB = ROLL CAMERA. The last function is only available when the viewport is a camera view.

Additionally, there are quick navigation options when Rightclicking on any viewport:

“Reset Viewport” will reset the viewport to a default perspective view.
“Look at Selection” applies to both camera and perspective view and it centers the selection on the viewport without changing the position of the viewer or the camera zoom.
“Center Selection” centers the current selection (objects and/or groups) in the viewport.
“Center Scene” centers the entire scene in the viewport.

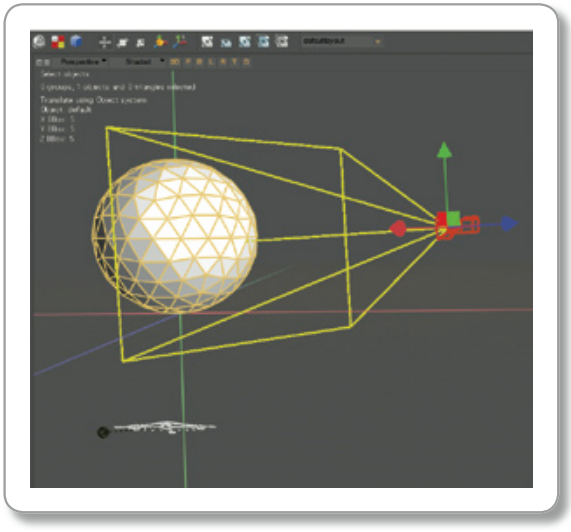
NAVIGATION OPTIONS



The Navigation option is available by using the right mouse button menu.

VIEWPORTS





2D / 3D VIEWPORTS:

Maxwell Studio provides perspective and orthographic viewports. The buttons at the top of the viewport allow you to quickly change between views:

"Perspective" allows you to change between the perspective/cameras point of view. When clicked, a menu will appear listing all the available cameras and perspective view.

The "Shaded" option will change the display mode of the window. Please see the Display Modes section for more details.

The button "3D" can be clicked to change to a 3D perspective view; by default it will show the last active perspective in that window.

Clicking any of the other letters will changes the viewport to orthographic views.

"T" FOR TOP
"D" FOR BOTTOM
"L" FOR LEFT
"R" FOR RIGHT
"F" FOR FRONT
"B" FOR BACK

DISPLAY MODES:

Maxwell Studio provides different display modes in the viewports. You can choose the appropriate mode by clicking on the display mode menu on the viewport title bar.

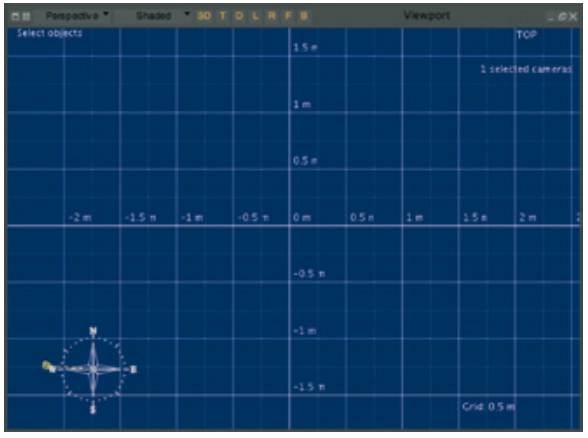
The following shading mode options are available:

- Bounding box: — only bounding boxes of the objects are shown.
- Wireframe: — only lines are shown.
- Hidden line: — like wireframe, but backfacing polygons are not shown.
- Flat: — flat shading.
- Toon: — cartoon shading.
- Shaded: — smooth shading.
- Texture decal: — textures are previewed in the viewport without shading.
- Textured: — textures are previewed in the viewport with shading.

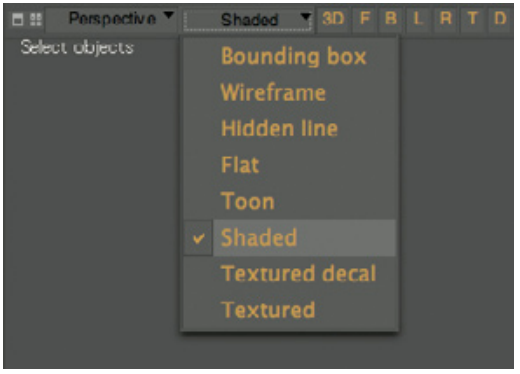
THE VIEWPORT GRID:

The grid visible in both 3D and 2D viewports gives you an indication of how big your objects are. For the 3D viewport, there is a grid size indicator at the bottom right of the viewport showing the current grid size. This indicator will change as you zoom in/out of the viewport and the grid spacing updates. The number of the grid size indicator tells you the distance between two bright lines of the grid:

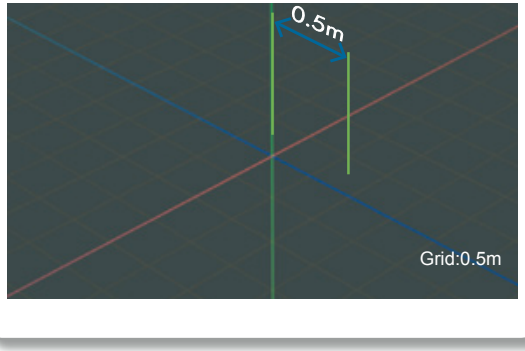
For the 2D viewports, the grid shows size indicators starting from the scenes origin and they increase from that point. You can also use an absolute grid (setting in the Studio preferences, OpenGL section), in which case the grid will show a fixed size, no matter the zoom level.
Note: that 2D grids will still show an adaptive grid.



DISPLAY MODES



GRID SCALE



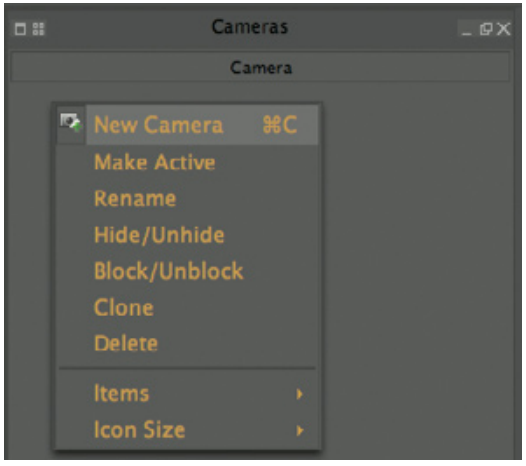
The Grid size is also indicated in the bottom right cornor of your window.

DISPLAY PREFERENCES



On the Mac this is under the MXStudio Menu>Preferences>OpenGL®

CREATING A CAMERA



DISPLAY PREFERENCES:

Display preferences are found in the main menu "Edit > Preferences > OpenGL®".

Set Colour
Colour of viewport backgrounds.

Threshold
Maximum angle to merge polygon lines shown in the viewport (this is only applied to OpenGL® display, no polygon lines are merged for rendering).

Display Selection Mode
Wire: selected objects will have their wireframe lit up in orange. Brackets: selected objects will display brackets surrounding them. This mode can be useful when adjusting textures on dense objects so the wireframe doesn't obscure the texture.

Enable Sky in new scenes
Physical sky will be on by default in new scenes.

Enable transparency for dielectric materials
Objects having transmittance other than black will be displayed with transparency in the viewport.

Vertex Buffers
Uses the vertex buffer feature of OpenGL® 1.5 to greatly increase viewport speed with heavy geometry. Disable this feature if you experience problems or artifacts in the viewport display.

Smooth Antialiasing
Enable / disable line antialiasing.

Lights
Number of lights used in OpenGL® viewports.

Texture Res
Texture resolution to use in the OpenGL® viewports.

Show bounding box when navigating
Acceleration mode showing the objects as bounding boxes when rotating/panning/zooming in the viewport.

Use absolute grid
By default the Studio grid adapts to the current zoom level. Using absolute grid allows you to specify a fixed grid. Spacing: distance between each grid line. Lines: nr of lines to display in the grid (ex. if Spacing is set to 1m, and Lines to 10, the entire grid will be 10m big). Major lines frequency: How often a thick grid line should appear (ex. if set to 2 every other grid line will appear thicker).

CREATING A CAMERA:

By default Maxwell Studio has a perspective visualisation mode that acts like a camera, but without all the possibilities of a real Maxwell camera. You don't have to necessarily create a camera to scene, but we do recommend it. This is so that you have more control over the final image look.

Use the viewport menu (Rightclick on viewport) and choose “New Camera” or press CTRL+C. This will add a camera with the point of view of your current perspective view. You can create as many cameras as you want. In the Camera list panel, Rightclick and choose “New Camera”.

Once a camera has been created, the camera frustum is displayed in the viewport. To switch to a camera viewport, click the viewport switch button icon in the upper left corner and choose the desired camera or double click on the camera in the Cameras List Panel.

Camera frustum (YELLOW FRAME)

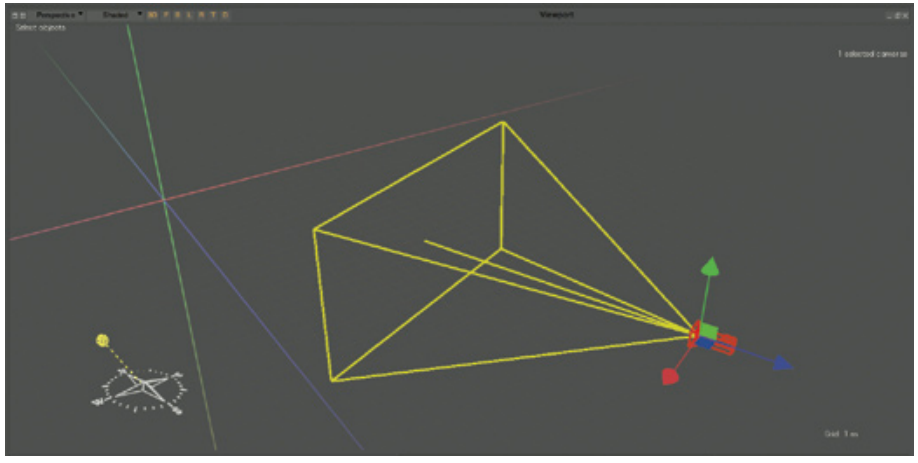
The camera frustum is adapted according to the resolution of the image set in the Camera parameters panel. When the render is launched from the camera view, only the region inside the frustum is rendered. The same applies when you launch a viewport render.

Selecting any camera in the Camera list panel will display that cameras properties in the Camera parameters panel.

MOVING A CAMERA:

Switch the viewport to “Camera View” and rotate, pan or zoom the view as explained earlier (ALT + mouse). This mode affects only the origin of the camera. In order to pan or rotate the camera as well as the target of the camera, use the shortcuts ALT + SHIFT + mouse.

The camera can also be moved using its translate handles:

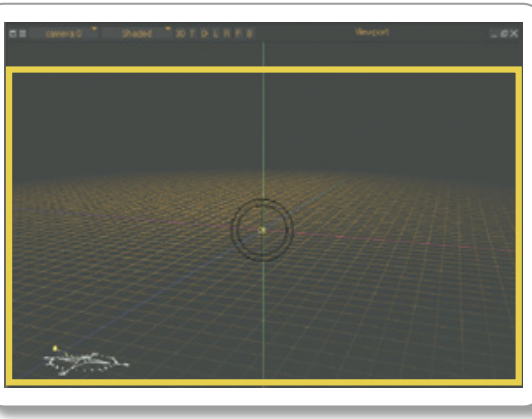


To move a camera using its handles, select it from the Camera list panel, and press the move icon from the top row of icons. The translate handles appear and you can move the camera without moving its target.

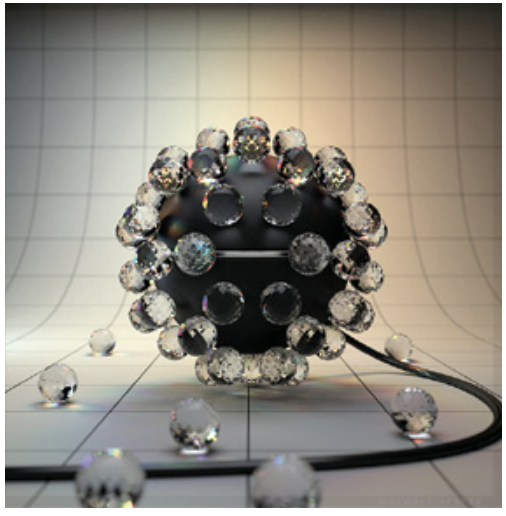
SWITCHING TO A CAMERA



CAMERA FRUSTUM



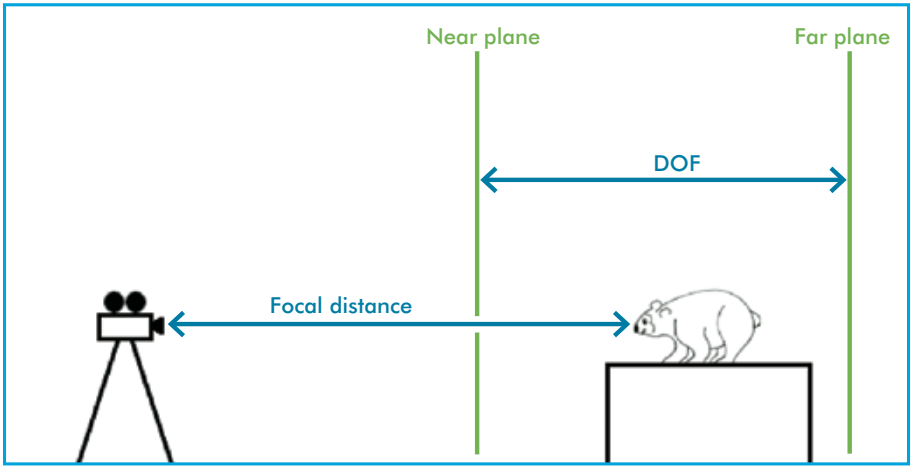
The yellow frame indicates the area of the camera frustrum.



DEPTH OF FIELD (DOF):

Maxwell's cameras are designed to work like real cameras, so it is important to understand first of all the concept of depth of field.

Consider the following image: The camera is pointing to the interest area (the koala). The focal distance should be the distance to the object in order to get a perfectly focused image. The near and far planes define the DOF area. Inside the DOF area, all objects are in focus.



The most important camera parameters to remember regarding the DOF are the f-Stop and focal length. The smaller the f-Stop (1.8, 2.2, 2.8) the smaller the DOF, meaning only a small area of the image will be in focus. With the focal length parameter, larger focal lengths will reduce the DOF, for example 50mm, 70mm, 100mm. A focal length of 24mm (typically called wide angle) will have a very large DOF, so almost all areas of the image will be in focus.

The Maxwell camera has a visual focus indicator that provides information about the focus conditions of the target. When the camera moves, the focus indicator changes according to the distance to the objects from the camera.

The focus indicator is composed of two circles and a rectangular indicator just in the center of the camera. When the target object (the central point of the circles) is exactly in focus, the rectangular indicator turns to yellow, otherwise it remains black.

A black rectangular indicator does not necessarily mean that the render will be out of focus, it also depends on the DOF distance. To measure if the camera target is inside or outside the DOF distance, the circles use blue or red colours.

The area of the circle with red colour means than the specific target area is beyond the far plane. Conversely, when the area of the circle is blue, the points are before the near plane. Areas in red and blue mean “out of focus” zone. Transparent areas are in focus. The yellow mark is the exact focal point.

Use the shortcut: Press the “I” key to disable or enable this information in the display.



DEPTH OF FIELD (DOF)

Beyond far plane = red = out of focus

DOF →

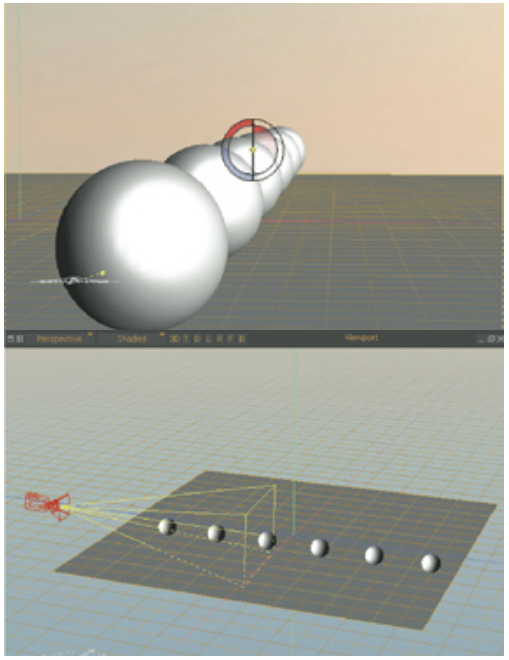


Before near plane = blue = out of focus

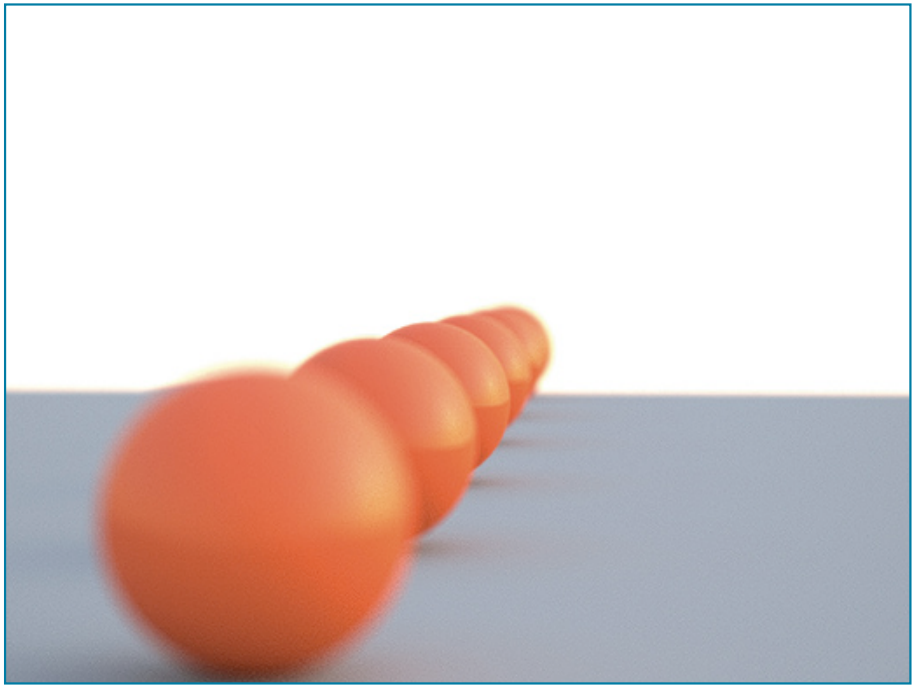
THE NUMBERS NEAR THE FOCUS INDICATOR REFER TO:

FD	=	Focal distance.
Near	=	Distance from camera to near plane.
Far	=	Distance from camera to far plane.
DoF	=	DoF distance (Far – Distance).

FOCUS INDICATOR



Focus indicator showing focus and out of focus areas. Focus is set on the third closest sphere.



Focus

Two additional functions “Auto focus” and “Focus to” are very helpful to control the focus of the camera. You can find these options by Rightclicking in the viewport.

Auto focus

Automatically focuses to the target point (what the focus indicator sees in the viewport). “F” key.

Focus to…

Choose this option and then click any point of the viewport. The clicked object will be in focus.

For the Auto focus and Focus options to work correctly, make sure you are not in Bounding Box or Wireframe shading modes.

SHIFT LENS:

The Shift lens functionality of the Maxwell camera allows you to shift the lens of the camera in order to move up/down, left/right the image that falls on the virtual film plane. This is useful for architectural type renders where you want to keep some lines of the building parallel, making a two point perspective.

X Offset: Defines the offset in X (side-side movement). Values can go from –100 to 100.

Y Offset: Defines the offset in Y (up-down movement). Values can go from –100 to 100.

ZCLIP:

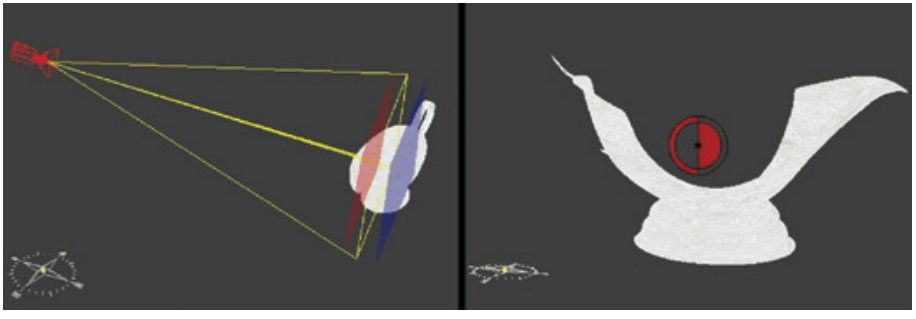
ZClip planes allow you to cut away parts of the geometry in a render by specifying the near and far clipping planes of the camera. This allows you for example to move the camera outside a room, and cut away the wall facing the camera so you can still get a render as if the wall didn't exist, although the actual render will take into account the wall and produce proper lighting.

ZClip check box: Enables ZClip.

Z Near: Define the near clipping plane. Anything before this plane will be clipped.

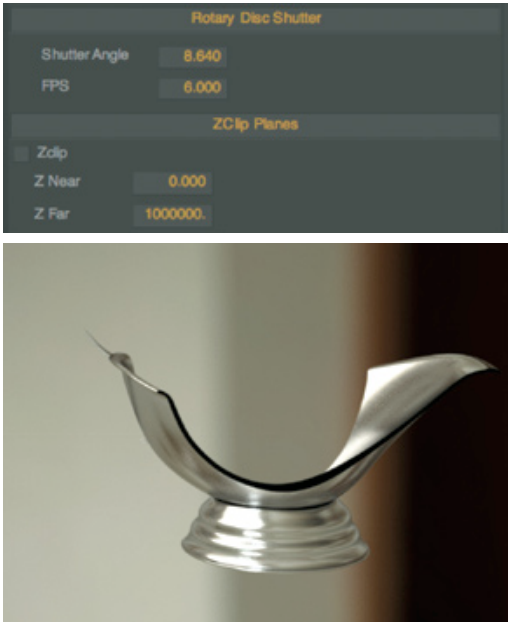
Z Far: Define the far clipping plane. Anything after this plane will be clipped.

The ZClip planes can be previewed either by looking through the camera in the viewport (you will then see the object being clipped as you move the ZClip planes) or looking in a perspective view and seeing the red (near plane) and blue (far plane) rectangles.

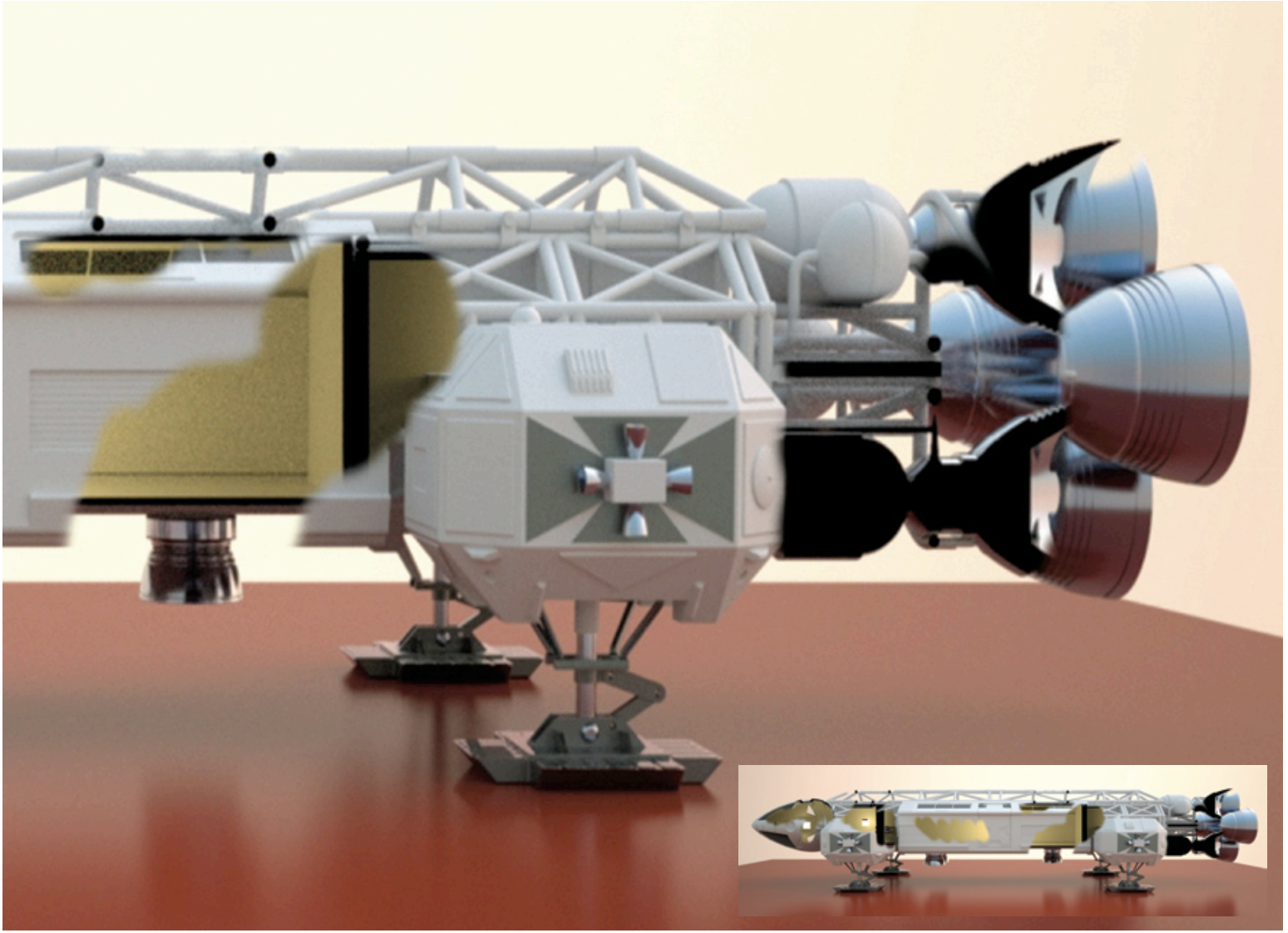


SEEING THE PLANES THROUGH PERSPECTIVE VIEW Vs SEEING THE ZCLIP DIRECTLY THROUGH THE CAMERA.

ROTARY DISC & ZCLIP PANEL



Resulting ZClip planes and a ZClip render.



PANEL TYPES

OBJECT LIST

Object list showing groups, objects and their materials.

The Object list panel is where all the groups and objects in the scene are listed in an Explorer style interface. The material applied to objects/groups are shown to the right. Further to the right is a lock icon allowing you to lock an object to prevent accidental movement. You can still apply a different material to a locked object. Each column in this panel can be resized by click dragging on the column separators.

Assign Material:
Select one or more objects and/or groups and select this option to apply a material to the selection.

Clone:
Create clones of your current selection.

Instance:
Create instances of the current selection

Group:
Select more than one object and select this option to create a group from the selection. A pop-up will appear allowing you to name the group. Groups can be nested to create hierarchies. Simply drag drop a group over another group or object.

Ungroup:
Select one or more groups and select this command to ungroup the objects contained in the group(s).

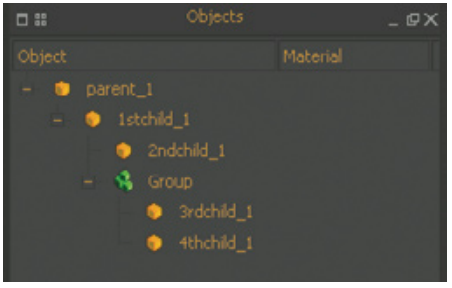
Group Triangles:
Select an object and switch to triangle selection mode, select some triangles and choose this command to make a triangle group from that triangle selection. The triangle group can be found in the Object parameters panel under the "Triangle Groups" tab.

New UV set:
Select one or more objects and click this button to create a new UV set for the object(s).

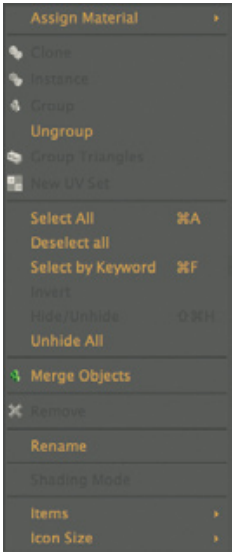
Select all:
All objects and groups will be selected.

Deselect all:
All objects and groups will be deselected.

OBJECT LIST

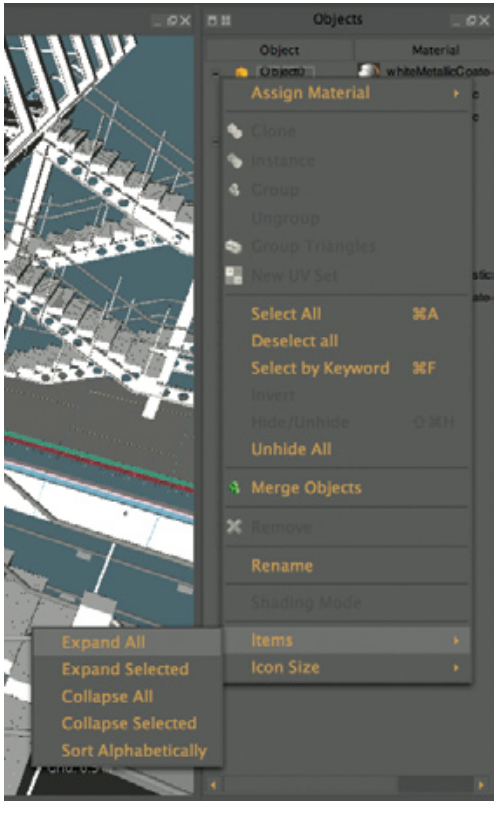


OBJECT LIST PANEL



Rightclicking in the Object list panel will open its options.

OBJECT LIST PANEL



By Rightclicking on the Objects window you can gain quick access to the dropdown menu.

Select by Keyword
A pop-up appears where you can enter a string of characters found anywhere in an objects name. For example if your scene contains the objects named "*Glass Container*" and *"Plastic Container"*, entering *"Contain"* in the pop-up will select both objects.

Invert
Inverts the current selection.

Hide/Unhide
Hides or unhides the current object/group selection from the viewport display and rendering.

Unhide All
Unhides all objects in the scene that were hidden.

Merge Objects
Select two or more objects and choose this command to merge them into one object.

Remove
Select one or more groups or objects. Choose this command to delete them. Note that objects in the group(s) will also be deleted.

Rename
Select an object or group and choose this command to rename it.

Shading mode
Set the shading of the current selection. Note that the shading mode set in viewport has precedence for "lower" shading modes. For example if viewport shading is set to wireframe, it will override the shading mode set per object. On the other hand if viewport is set to Textured, and you set object shading to Wireframe, the objects will be displayed in wireframe.

Items
This menu item contains several options:

Expand All	—	Expands all objects and groups.
Expand Selection	—	Expands all selected objects and groups.
Collapse All	—	Collapse all objects and groups.
Collapse Selected	—	Collapse all selected objects and groups.
Sort Alphabetically	—	Sort all objects and groups alphabetically.

Icon Size
Set the size of the icons displayed in the object list.

OBJECT PARAMETERS

When a group or a set of objects are selected in the Object list panel, the Object parameters panel will show the list of parameters that can be changed for that selection. The panel is divided into several sections which can be expanded/collapsed by clicking on the section title:

GEOMETRY SECTION

Position: X, Y, Z world position of the object(s).

Rotation: Euler angles of the object(s).

Scale: X, Y, Z scale of the object(s).

PIVOT SECTION

Center pivot: Set the pivot point to the geometric center of each object.

Pivot Position: X, Y, Z position of the pivot.

Pivot Rotation: Euler angles of the pivot.

DISPLAY SECTION

Hidden from Camera: Hide the object from the render view but have it participate in the render calculation (cast shadows, refract etc).

Hidden from Reflection/Refraction: Reflected or refracted objects are hidden (seen in enough specular materials or with low roughness; like a vampire in a mirror).

Hidden from GI: Means the object will render but will not affect lighting.

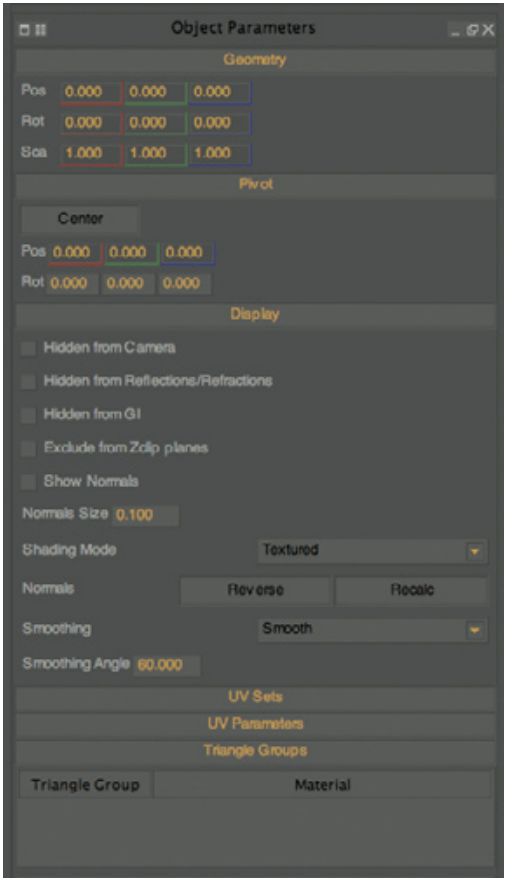
Exclude from ZClip: If this option is selected, the object won't be cut by ZClip planes.

Show normals: Show the normals of the object in the viewport.

Normal Size: The display length of the normals.

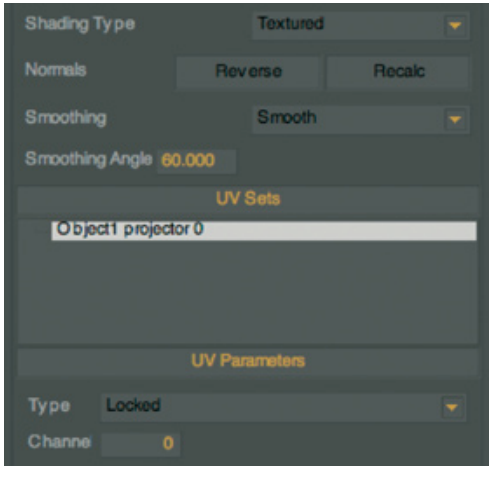
Shading Type: Choose the display mode for the selected object(s).

OBJECT PARAMETERS 1

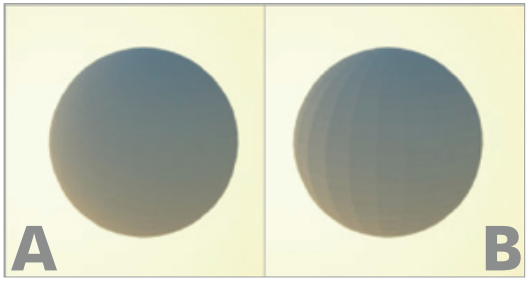


Object panel with Geometry, Pivot and Display sections expanded.

OBJECT PARAMETERS 2



SMOOTHING



Sphere A: with smoothing on. Sphere B: with smoothing set to Flat.

Normals: Reverse: This will change the renderable side of the polygon by changing the direction of the normal vector. It is relevant with objects that have got emitter or dielectrics materials applied.
Recalc: Recalculate the objects normals. This parameter can help remove rendering artifacts due to corrupt normals of an imported object.

Smoothing: Choose whether to smooth objects at render time, or if the object(s) should not be smoothed (Flat).

Smoothing Angle: Angle of smoothing. If the angle between adjacent polygons is smaller or equal to this angle, they will be smoothed.

UV SETS SECTION

Displays all the UV sets belonging to the current object. Note that only one object has to be selected for the list to display the UV sets. To know more about how to create an UV Set please refer to page number 91.

UV PARAMETERS

Lets you edit the parameters of the currently selected UV set. For more info about working with UV sets in Studio, see section on page 91. To edit a UV set you need to set it to something other than “Locked”. You can select several UV sets at the same time and edit the properties for all of them.

Type: Lets you choose the type of UV set needed for the object. There are four types of UV sets available: Flat, Spherical, Cylindrical and Cubic. Objects imported which already had UV sets will have their UVs imported as “Locked”. This UV type does not allow any editing. You can also set a current UV set to Locked to avoid editing it by mistake.

Channel: Set the UV channel that this UV set will represent. The UV channel is used when applying textures to a material in the material editor, you specify the UV channel that texture should use. For example an object may have two UV sets, one spherical (channel 0) and one flat (channel 1). A material applied to this object can use both the spherical UV set and the flat UV set. In the material editor, you can set one texture to use channel 0 and another texture to use channel 1.

Position: The position of the UV set relative to the position of the object it is applied to. 0,0,0 means the UV sets pivot is at the center of the object it is applied to.

Rotation: The orientation of the UV set relative to the orientation of the object it is applied to. 0,0,0 means the UV set has the same orientation as the object it is applied to.

Scale: The size of the UV set in relative to the object.

Adjust to object: Pressing this button will adjust the position, rotation and scale of the current UV set to the global position, rotation and scale of the object it is attached to.

TRIANGLE GROUPS

Show all triangle groups belonging to the selected object. Note that only one object has to be selected for the list to display the triangle groups.

To view the triangles associated with a triangle group, make sure you are in Triangle Selection mode and select a triangle group. The triangles appear in the viewport.

You can drag and drop a material from the material list onto a triangle group to assign that material to just that triangle group. You can also select a triangle group in the list, and then drag and drop a material directly in the viewport. To remove a triangle group, select it and press the Delete key on your keyboard. Additionally if you Rightclick on a triangles group a menu will pop up:

Merge: This will merge two selected groups and will leave the material of the first selected to the new merged group of triangles.

Recalculate: This option will recalculate the group to add or remove some triangles.

Rename: For renaming a group.

Remove: Same as the delete key, it will remove the triangle groups but not the triangles themselves.

MATERIAL LIST

All the materials currently loaded in the scene are listed in the material list, including those that are not assigned to any object.

NOTE: To keep your MXS files tidy and clean we recommend you to Remove unused materials before rendering. This way MXCL won't expend time looking for textures of unassigned materials.

If a material has already been previewed in the material editor, a smaller version of the preview thumbnail will appear next to each material. If the material has never been previewed an icon with a red 'X' will appear next to it.

A material can also be dragged from the Material Browser panel into the Material list panel.

New Material: Create a new material.

New Emitter: Create a new emitter material.

Import MXM: Imports an .MXM (Maxwell material file) into the material list.

Clone Material: Creates a clone of the currently selected material.

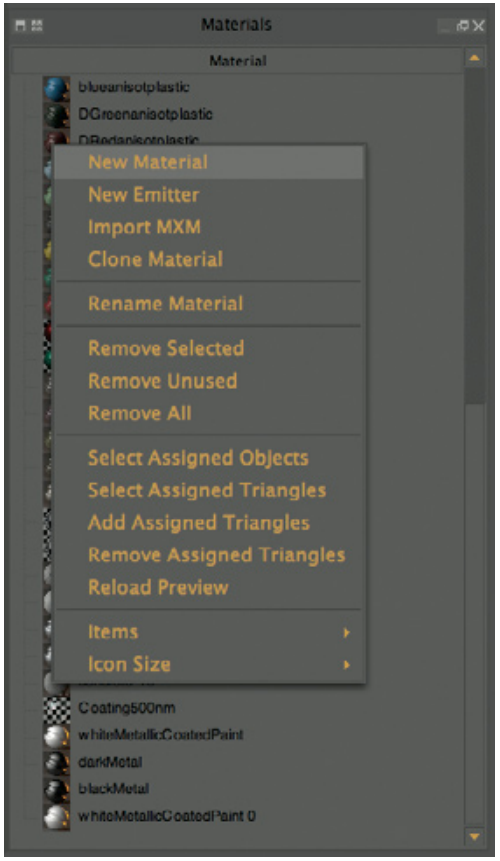
Rename Material: Shortcut for this command is F2.

Remove Selected: Removes selected materials from the scene.

Remove Unused: All materials that are not applied to any object are removed.

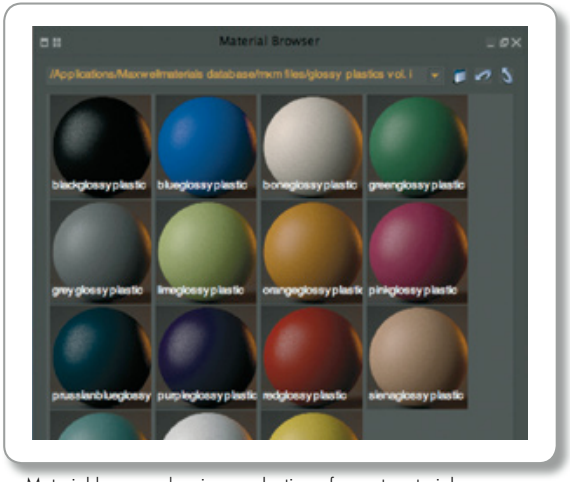
Remove All: Removes all the materials from the scene.

MATERIAL LIST PANEL



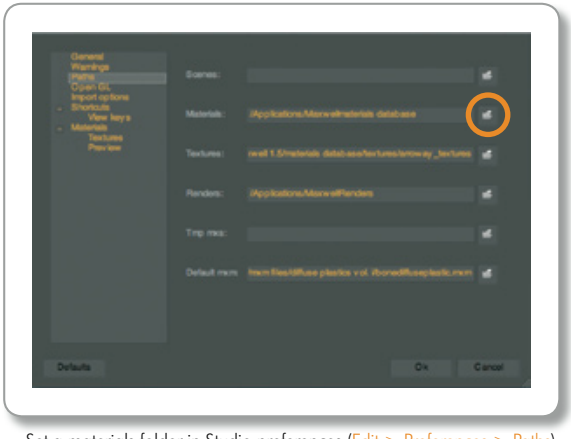
Rightclicking in the material list reveals the following above menu.

MATERIAL BROWSER PANEL



Material browser showing a selection of preset materials.

PREFERENCES PANEL



Set a materials folder in Studio preferences (Edit > Preferences > Paths)

Select Assigned Objects: Select a material and choose this option to select all objects that have this material applied.

Select Assigned Triangles: Select a material and choose this option to select all triangles that have this material applied.

Add Assigned Triangles: If you already have selected some triangles in the scene, use this option to add to that selection all triangles that have this material applied.

Remove Assigned Triangles: If you already have selected some triangles in the scene, use this option to remove from that selection all triangles that have this material applied.

Reload Preview: Select one or several materials and choose this option to generate a new preview for all the selected materials at once.

Items: This menu contains the option to sort the materials alphabetically.

Icon Size: Set the size of the icons displayed in the material list.

MATERIAL BROWSER

This panel provides a way to browse the Maxwell materials available on your system. It is also available in the MXED, the standalone material editor. For every MXM file found in the material database, the material browser shows a small preview of the material.

Within the Maxwell installation folder there is a material database that you can browse. If you have set a materials folder in Studio preferences (Edit > Preferences > Paths), the Material Browser will open in that folder.

Assigning/adding materials from the browser is done by drag and drop, in one of three ways:

1. Drag and drop a material onto a selected object or group of triangles in the 3D/2D viewports. This action will add the material to the current scene and assign it to the object/triangles.

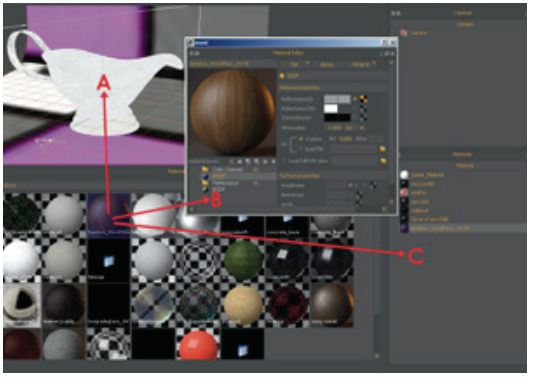
2. Drag and drop the material to the material list (both from the browser in Studio or from the browser in MXED). The material is added to the list, but not assigned to any object.

3. Drag and drop the material into the material editor (both from the browser in Studio or from the browser in MXED). The material is added to the material list and is also opened in the material editor for editing. The material is not assigned to any object.

A material can also be dragged from the Material list into the Material Browser, which is an easy way of creating your own material libraries. Several materials can also be selected at once and dragged to the Material Browser.

A – from browser (MXST or MXED) to the selected object /triangles.
B – from browser (MXST or MXED) to the material editor.
C – from browser (MXST or MXED) to the material list.

DRAG & DROPPING MATERIALS



CAMERA PARAMETERS

The camera parameters hold all the settings for the Maxwell cameras. For more info about working with the cameras, see the section on page 64.

Block: Checking this option will not allow to change the camera parameters.
Hide: Checking this option will hide the camera in the viewports.

POSITION

Camera: X, Y, Z world coordinates of the origin of the camera.

Target: X, Y, Z world coordinates of the target of the camera.

Focal distance: Distance from the camera to the camera target.

Roll Angle: Rolling angle of the camera (in degrees).

OPTICS

Shutter: The shutter speed, specified in 1/n of a second.

f-Stop: Controls the aperture of the lens.

Focal Length: The focal length of the lens.

RESOLUTION

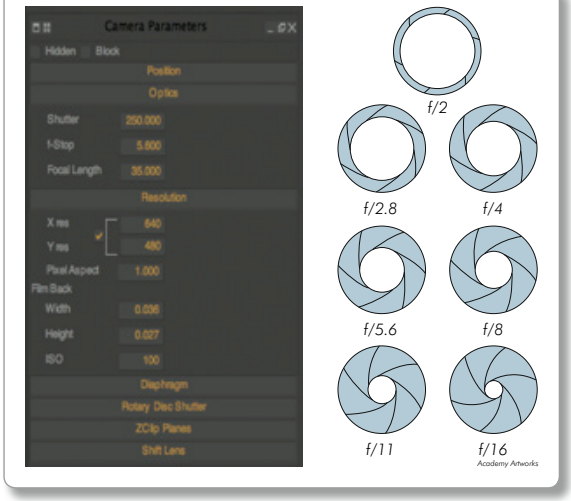
X res: The X (width) resolution of the image.

Y res: The Y (height) resolution of the image.

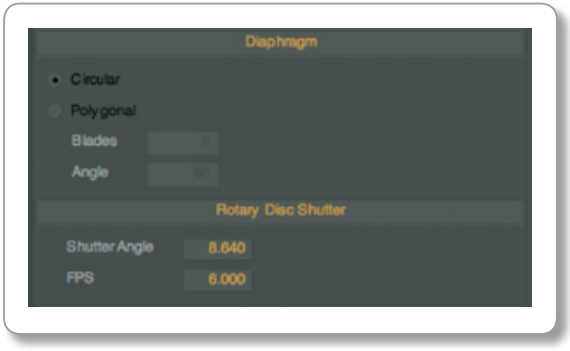
Keep image aspect check box: Keeps the image aspect ratio when changing the width or height of the image resolution and/or the film back width/height.

Pixel aspect: Width–height proportion of the pixels. Useful when the rendering output will be displayed on devices which have non-square pixels, such as television sets.

RESOLUTION & OPTICS F-STOP



DIAPHRAGM PANEL



FILM BACK

Width: Camera film width.

Height: Camera film height.

ISO: Sensibility of the film.

(Higher ISO number means the virtual film is more sensitive to light).

DIAPHRAGM

Diaphragm type: Choose Circular or Polygonal. This controls the shape of the *"bokeh"* effect caused by bright spots in the image that are out of focus.

Blades: Number of blades (for Polygonal diaphragm).

Angle: Angle of the blades (for Polygonal diaphragm).

ROTARY DISC SHUTTER

Shutter Angle / FPS:

Enabling this check box allows the amount of motion blur in an image to be affected properly by the Shutter Angle parameter found in animation cameras. For still camera photography (Maxwell Render's default), the amount of motion blur in an image is controlled by the Shutter Speed parameter. The lower this value is, the longer the shutter is open, and the more pronounced the motion blur will be. However, for animations – where you are replicating a film camera - the shutter speed is generally fixed to a certain speed, usually 24 frames per second (1/24). Since film cameras can't control the amount of motion blur by changing the shutter speed, they instead have a rotating disc with an adjustable pie-shaped cut out on it, which controls how long each frame is exposed. The width of the cut-out is called Shutter Angle, and is expressed in degrees. Fully open (180 degrees) will yield the maximum amount of motion blur, while a very narrow setting (say, 15 degrees) will produce very subtle motion blur. This feature automatically translates your usual ISO/Shutter speed settings in combination with the Shutter Angle, so your animation exposure will match your still image exposure, while producing the proper amount of motion blur.

Maxwell Shutter (exposure) = FPS * 360 / Shutter Angle.
Shutter Angle = FPS * 360 / Maxwell Shutter (exposure).
% of blur = Shutter Angle * 100 / 360.

CAMERA LIST

This panel lists all the cameras in the current scene. Rightclicking in the camera list panel shows a menu with the following options:

New Camera: Creates a new camera, shortcut Ctrl+C or Command+C (Mac).

Make Active: This option will set the selected camera as the rendering camera and also switch the viewport view to this camera.

Note: that you can also double click on the camera to make it the active camera.

Rename: Rename a camera, shortcut F2.

Hide/Unhide: Hide or unhide a camera from the scene. The camera can still be used to render.

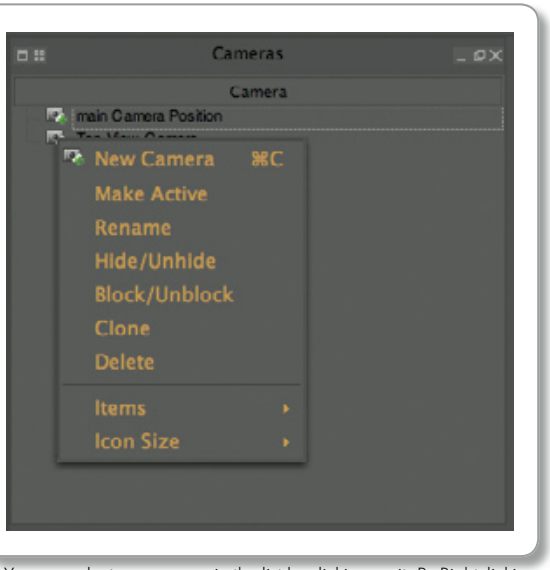
Block/Unblock: Block or Unblock a camera to prevent accidental movements.

Clone: Clones the currently selected camera.

Delete: Select one or more cameras and choose this option to delete them from the scene.

Items: Sort cameras alphabetically.

Icon Size: Set the size of the icons displayed in the camera list panel.



You can select any camera in the list by clicking on it. By Rightclicking in the camera list panel will display the panel dropdown menu.

ENVIRONMENT SETTINGS

Environment lighting options in Maxwell Render™ are grouped under this panel. Choose from the drop-down list the type of environment lightning you want:

NONE:

This will turn off all environment settings. Perfect for setting up emmiter based projects.

SKY DOME:

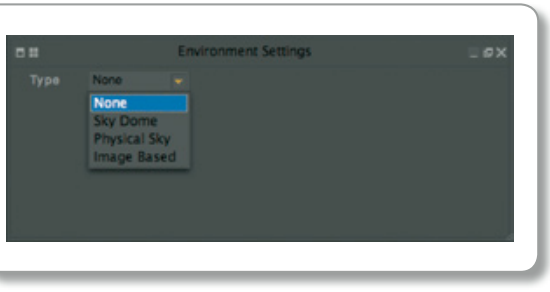
This option represents a uniform colour sky. Click the "Settings" tab to expand its settings.

Set Colour:
Clicking on this button will open a colour picker to choose the dome colour.

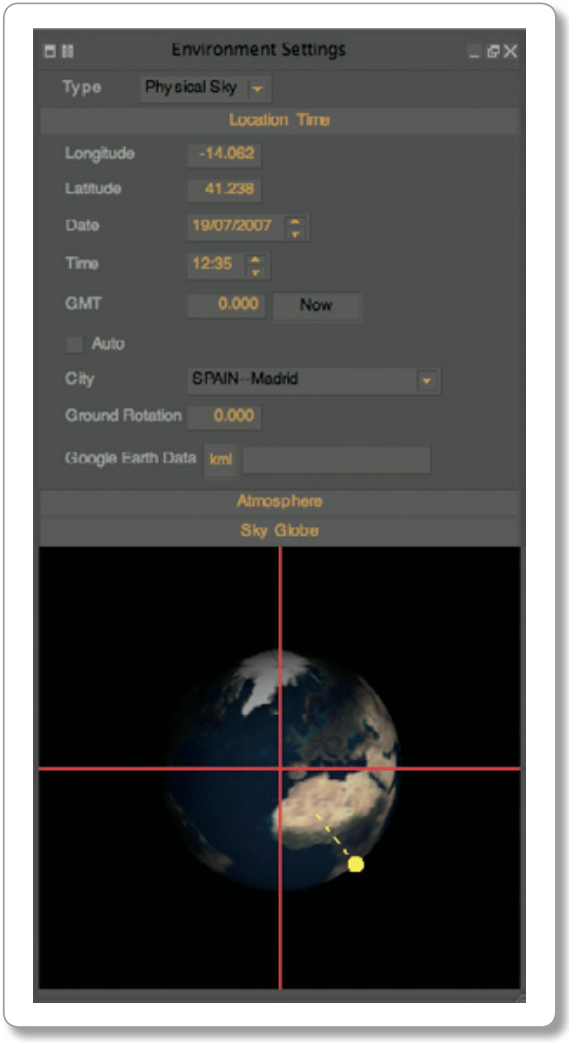
Intensity (lm):
Type in the intensity of the sky dome in lumens.

Use physical sun
This will use the sunlight from the current date/time/location of the Physical Sky settings.

ENVIRONMENT SETTINGS PANEL



ENVIRONMENT PANEL



PHYSICAL SKY:

Maxwell Render™ provides a physical sky model that reproduces the skylight conditions at different locations/dates/hours. When the sky is enabled, the viewport shows a visual representation of the sky that can be enabled and disabled by pressing the "**K**" key.

LOCATION TIME

Longitude/Latitude: Earth positions to calculate the sky/sun light direction.

Date: Set the date.

Time: Set the time.

GMT offset: Set the Greenwich Mean Time offset of the longitude/latitude location.

Now: Press this button to set the time and date to your computer's current time and date.

Auto: Enables the Auto GMT function. This function updates the GMT automatically as you move the Sky globe or change the longitude/latitude.

City: List of cities for quickly choosing a location. The list is a text file which you can edit to add/delete locations. It can be found in your Maxwell install folder (cities.txt).

Ground Rotation: Allows you to rotate the north direction. This is useful when you want to reposition the sunlight without changing the location or date/time settings which would change the sky illumination.

Google Earth™ Data: Allows you to import a KML file to set the location.

ATMOSPHERE

Sun: Enable or disable direct sunlight. The direct sun light can be enabled or disabled independent from the sky light.

Turbidity / Ozone / Water: Physical properties of the sky, slightly affect the colour components of the sky. Increasing turbidity gives a warmer yellow tone, increasing Ozone gives a colder blue tone.

SKY GLOBE

You can interactively rotate the Earth in the display, to change to a different location. Use Alt+LMB to rotate and Alt+RMB to zoom in/out. The shortcut key **"K"** enables or disables the sky representation in the graphical viewport.

The graphical viewport shows the geographical directions (N, E, S & W) by means of a compass located in the bottom left corner. The sun is represented by a small yellow sphere that points to the sun direction. When the sun is below the horizon, the yellow sphere fades to black.

IMAGE BASED:

Applies an HDR, MXI or EXR image file to a spherical environment. These three image formats store high dynamic range data, providing accurate environment lighting.

NOTE: That there are several available channels for specifying MXI/HDR/EXR maps; this is a very powerful feature as it allows the user to have more control over the effects of the environment on the scene. For example you can use one MXI/HDR/EXR map for illuminating the scene, and another map for the reflections.

Background channel: Allows the addition of an MXI/HDR/EXR map as a background environment, not for emission purposes but for having a background image in the scene. Screen mapping can be used to map the MXI/HDR/EXR image to screen coordinates.

Reflection channel: Add an MXI/HDR/EXR map for reflections on scene objects.

Refraction channel: Add an MXI/HDR/EXR map for refractions on scene objects.

Illumination channel: Add an MXI/HDR/EXR map as a background emission.

Each channel can be edited separately. The following options are available for each channel:

Browse button: For selecting the MXI/HDR/EXR map.

Disable channel: Map will not be used for rendering.

Intensity: Adjust the contribution of the map for scene illumination/reflections/refractions.

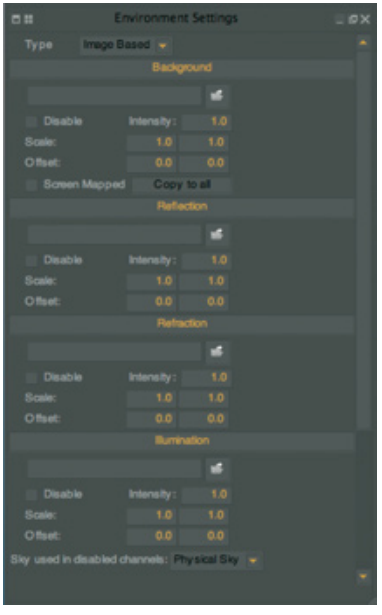
Scale: For scaling the current map.

Offset: For rotating the spherical environment in X and Y axis. 0 - 100 represents rotation from 0 - 360°.

COMPASS



Compass and Sun direction.



The Image Based dialogue panel.

RENDER OPTIONS PANEL



The General options panel is highlighted here.

Sky used in disabled channels adds an extra control over the environment. If any MXI/HDR channels are disabled, you have the option to use the SkyDome, Physical Sky or None to replace the disabled channels.

Additionally there is a "Copy to All" button in the Background Channel section. This lets you copy all the settings including the map from the Background Channel to all the other channels.

RENDER OPTIONS

The "Render Options" panel shows the different controls related to the rendering process:

GENERAL

Time (min): Set the maximum render time (in minutes) for the render. The longer the time is, the cleaner and more accurate the image you will obtain.

Sampling Level: Maximum sampling level required. The render will stop when this SL is reached. As with the "render time" parameter, the higher sampling more accurate the image you will obtain.

CPU Threads: Number of threads dedicated to the render. By default 0 threads means that all available CPUs are used. In special situations you may require less threads if the machine is working on other tasks. Note that one core in a multi core CPU is considered 1 CPU thread.

Low Priority: Enabling this option gives the Maxwell render process a low priority. Useful if you wish to work on your computer while rendering.



Maxwell will finish the rendering process when one of these conditions "Render time" or "Sampling level" is met. If you want to finish at some specific render time, set a very high sampling level, and conversely, if you want to reach a specific sampling level, set a very high render time.

OUTPUT

MXS: Specify a name and path for the current scene to be rendered. You can specify another name than the currently loaded scene and Studio will save it under that name before starting the render.

IMG: Specify a name along with suffix (eg. .jpg, .bmp, .tif, .tga, .png) and path for the image file created when rendering. An image file is always created when rendering, if you don't specify a path and name, it will be saved as "default.png" in your Maxwell install folder.

NOTE: If you have specified a "Renders" path in your Studio preferences, you can simply enter a name with suffix without specifying the path and the image file will be saved to that folder.

MXI: Specify a name and path for the .MXI file created when rendering. An MXI file is always created when rendering, if you don't specify a path and name, it will be saved as "default.mxi" in your Maxwell install folder.

NOTE: If you have specified an MXI path in your Studio preferences, you can simply enter a name without specifying the path and the MXI file will be saved to that folder.

Multilight™ Enabled: Enables the Multilight™ feature.

Disable Bitmaps: No textures will be used when rendering and all materials will be replaced by a default Maxwell material.

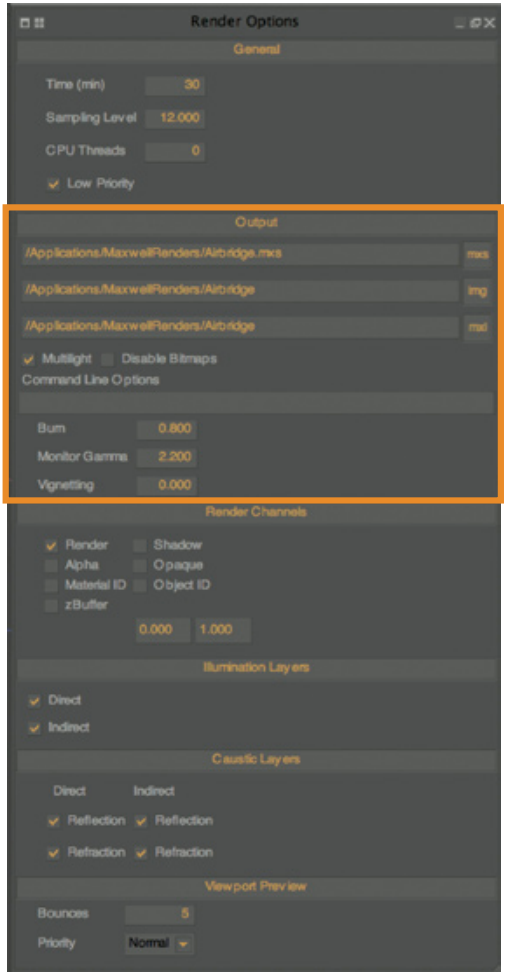
Command Line: Text box where you can enter any command line option (please refer to page 111). Any of the commands entered here will overwrite the render options. As an example, you can render to a test resolution from command line without losing the final render parameters specified in Resolution parameter in the Camera Parameters panel.

Burn: Parameter to control the highlights in a render. Lower burn values will decrease the intensity of the highlights to avoid "burned out" areas in the image. In most cases this parameter should be left at default. Lowering it too much may produce unnatural looking images.

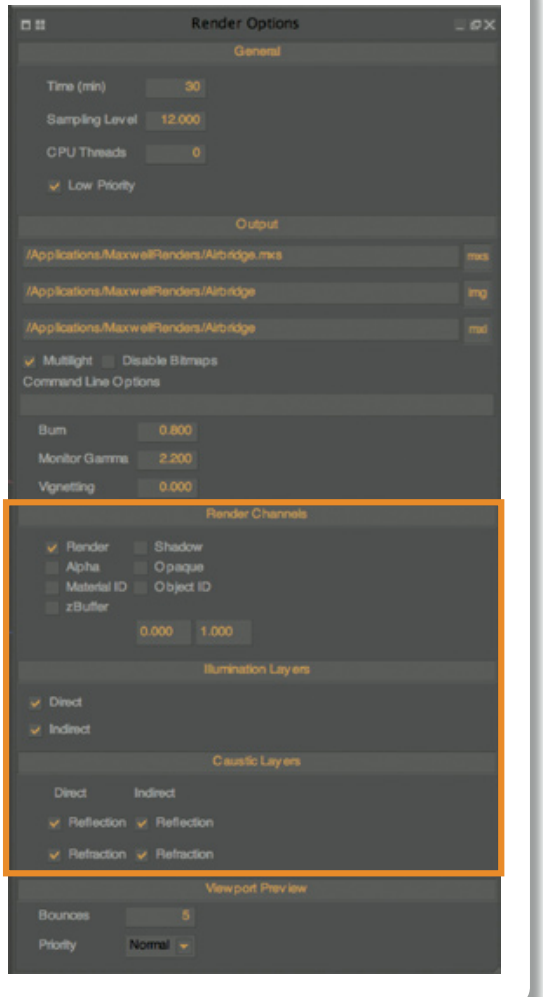
Monitor Gamma: Maxwell internally uses a gamma of 2.2 to convert from spectral space to RGB space. You can use this parameter to control the gamma conversion. Lower gamma values darkens the image, higher values lightens the image. Note that you can control this parameter interactively while rendering in MXCL.

Vignetting: Vignetting is an artifact darkening the image through the edges due to camera optics, now you can partially or completely remove it by dragging the slider from 1000 to 0.

RENDER OPTIONS PANEL



RENDER OPTIONS PANEL



RENDER CHANNELS

Several render layers are available, useful for compositing tasks. Calculating more layers will take extra time at the beginning of the rendering phase. The output will be saved in the same directory as set in the MXCL Render Path.

Render: Output the main render image.

Alpha: Output the alpha image.

Object ID: Output multicoloured material silhouettes.

zBuffer: Output an image representing scene depth within the two values specified in zBuffer range. The range is in meters.

Shadow: Shadow Pass shows the cast shadows of the materials with the "Matte Shadow" Flag enabled.

Material ID: Output multicoloured object silhouettes.

ILLUMINATION LAYERS

Choose whether to render direct lighting, indirect lighting or both. Render time could be slightly reduced when disabling any of these layers.

Direct: Enables the direct lighting render layer. Direct lighting is considered light that falls directly on objects.

Indirect: Enables the indirect lighting render layer. Indirect lighting is considered light that has already bounced off of another object.

CAUSTICS LAYERS

Controls the rendering of caustics. Render time could be slightly reduced when disabling any of these layers.

Reflection – Direct: Enables the direct reflected caustics (if direct layer is enabled). These are caustic light patterns caused by direct light bounced off reflective objects.

Reflection – Indirect: Enables the indirect reflected caustics (if indirect layer is enabled). These are caustic light patterns caused by indirect light bounced off reflective objects.

Refraction – Direct: Enables the direct refracted caustics (if direct layer is enabled). These are caustic light patterns caused by direct light going through refractive objects.

Refraction – Indirect: Enables the indirect refracted caustics (if indirect layer is enabled). These are caustic light patterns caused by indirect light going through refractive objects.

VIEWPORT PREVIEW

Set the options for the preview rendering in the viewports.

Bounces: Number of bounces for the preview renderer (more bounces, the slower and more accurate the preview).

Priority: Set the CPU priority of the viewport preview rendering.

HISTORY

The History panel records almost all edits you make in Studio and lets you step backwards or forwards through the list of changes. Simply select one of the entries to move through the history. You can purge the history list from Edit > Purge History.

INSTANCES

This panel lists instances for the selected object.

Instances can be generated via plugins. Please note that not all the plugins are able to generate instances, so please check the specific plugin manual to know more.

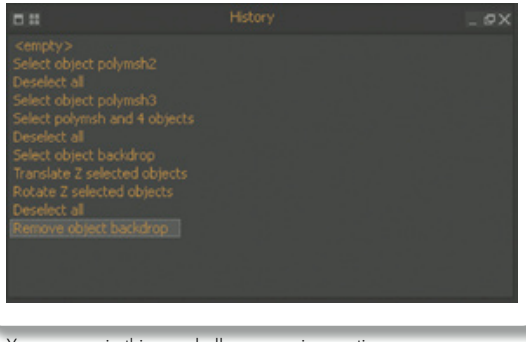
Instances are a memory saver for making multiple copies of an object. You could have for example 10000 instances of an object, and during rendertime, MXCL will use the same amount of memory as if you were rendering 1 real copy of that object. Examples of uses can be trees, bricks, stones, furniture, etc…

Maxwell Instances have got some specifications that are worth knowing to use them correctly. Instances cannot emit light, so if an emitter material is applied to the initial object, the copies will be automatically transformed into real geometry when the MXS file is saved. Meaning this you won't get advantage of the memory savings because you'll have real copies of the initial object.

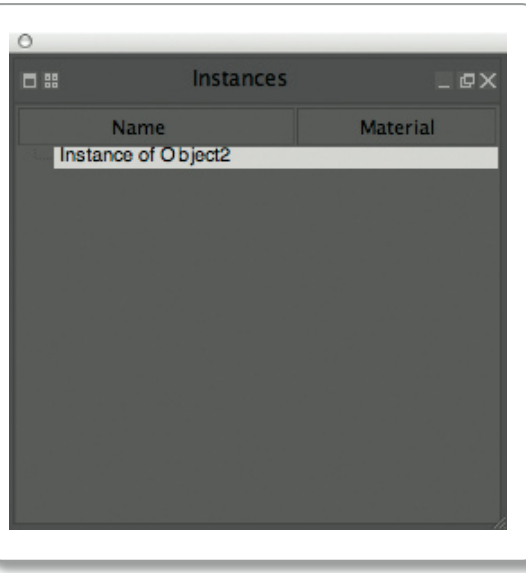
Instances will inherit the material applied to the Initial object unless otherwise specified. Each instance can have its own material, different from other instances. You can drag and drop a material from the material list to an instance in the Instances panel to apply another material to it. However we have to take a closer look in the case of multimaterial objects. Instances will inherit multimaterial properties from the initial object but the user cannot specify multimaterial directly to an instance.

Motion blur doesn't currently work on instances, so like in the emitters case, they will be transformed into real copies.

HISTORY PANEL



You can see in this panel all your previous actions.





WORKING WITH OBJECTS:

IMPORTING OBJECTS

Currently, the file formats supported are: MXS, OBJ, STL, LWO, XC2, DXF, 3DS, FBX (All Plan 2005). Some of these formats only store one single object while others support any number of objects. Maxwell requires these formats to provide 3D polygonal data as triangles. Other geometry formats are not supported.

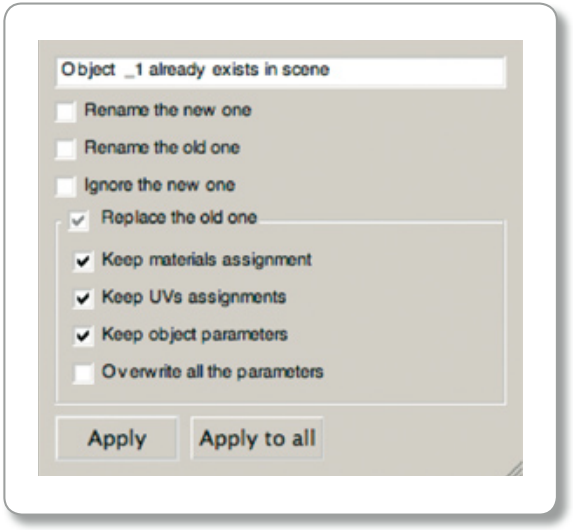
Another alternative to importing geometry into Studio is to save a MXS scenes (Maxwell scene file format) with the Maxwell plug-in for your application, and opening or importing that scene into Studio.

There are three possible ways to import objects into Studio:

1. Use the menu command "File > Import".
2. Rightclick in a graphical viewport, and choose "Import".
3. Drag and drop an object from your file explorer into the object list panel or viewports.

When Maxwell Studio saves the scene, the geometry is packed in an MXS file, therefore the original object files are no longer needed.

IMPORTING OBJECTS



RENAMING OBJECTS

Select an object and press **"F2"** to rename it.

REPLACING OBJECTS

If you need to replace an object in the scene with an updated one, you can simply reimport it and Maxwell will recognise the object with the same name already existing in the scene. It will show you a pop-up asking you what to do with the new object.

This is a very practical feature, as the geometry of the objects can be changed without removing all the material properties.

USING PRESET OBJECT LIBRARIES

It is also possible to load any of the preset scenes and objects available with the installation by clicking on "File > Load Environment" and "File > Load Object from Library".

By loading any of the environments the user will have a studio-like environment to render their own objects. Please note the environments are set to match a certain scale, please keep this in mind when choosing an environment. Users can also create their own environments and objects by simply saving their scene in the “studio environments” folder or the “objects library” folder found in the Maxwell install folder. They will then be available from within Studio for quick loading.

SELECTING OBJECTS

Objects can be selected in the 2D/3D viewports by clicking single objects with the left button or dragging a region with the left button pressed. Selected items will be highlighted.

Shift + Left click	—	will select additional objects.
Ctrl + Left click	—	will deselect the object.

Press **“ESC”** to deselect all objects.

The objects can also be selected in the Object List Panel. Shift and Ctrl can be used as with the viewport selection.

NOTE: If an object is imported with motion blur and selected it will display motion blur vectors.

Selecting by using a region

There are more options for working with object selections, available by Rightclicking in the 3D/2D viewports, or in the Object list panel. These options are explained in the MAXWELL STUDIO: PANEL TYPES section on page 71.

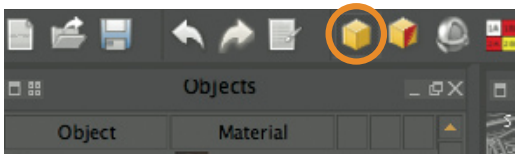
MOVE / ROTATE / SCALE

In order to move, rotate or scale any objects, they must be selected previously. You can edit one or more objects at the same time. Switch to object editing mode using the icons in the upper toolbar or using the keyboard shortcuts Q (all), W (move), E (rotate), R (scale).

You can move, rotate or scale the selected objects dragging the axes or using the numerical inputs in the Object parameters panel. For the numerical inputs, you can press the middle mouse button inside an input box, and drag the mouse up/down to interactively change the values.

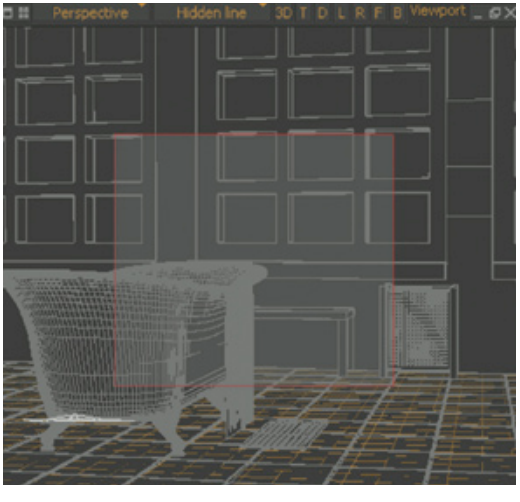
Additionally you can use the mouse scroll wheel or hold down the Ctrl key to change values in larger increments.

SELECTING OBJECTS



Make sure you are in object selection mode.

SELECTING BY USING A REGION



MOVE/ROTATE/SCALE



SELECTION MODES

There are different selection modes accessible through the icons in the main toolbar or with the keyboard shortcut **"T"**. By default, the selection mode is set to "Object".


Object selection: Select objects.


Group selection: Select only groups.


UV set selection: Select only UV sets.


Triangle selection: Select only triangles.


Material selection: This is useful to "pick" the material assigned to an object or face. The material will be selected in the Material list panel.


Instance selection: Select first an object that has instances, then click this button to select the objects instances in the viewport.

Extra features to improve the triangle selection process are available from Selection > Polygon Selection and Selection > Polygon Selection Mode.

Selection menu

+ Key will expand the selection to the neighbour faces. Pressing the key **"+"** several times will propagate the selection to the next neighbor faces of the current selection. Faces you want to become selected must be connected.

- Key will do the opposite of key **"+"** reducing the selection to the inner neighbor faces.

/ Key (SLASH) will expand the selection to contain all the connected faces.

* Key (ASTERISK) will invert the current selection.

Key F8 – F9 – F10 – F11 switch amongst different triangle selection modes:

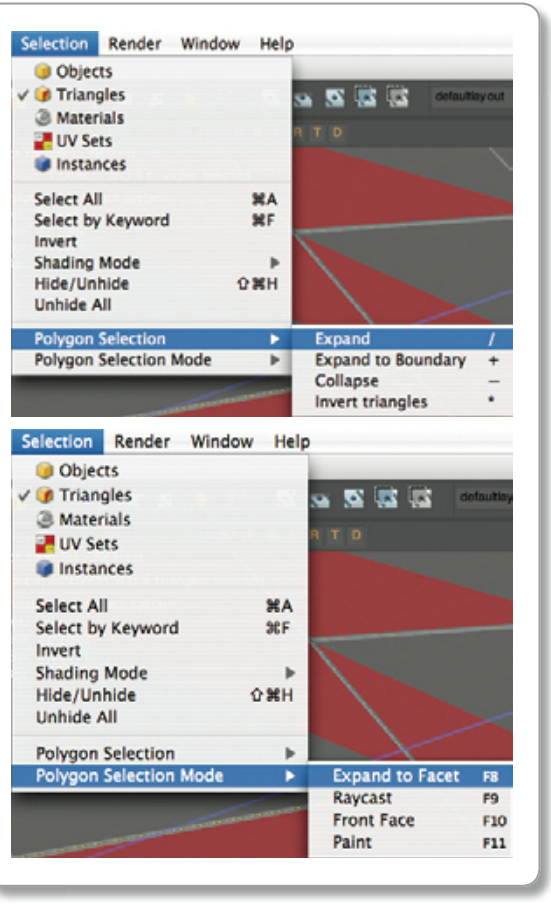
Set expand to facet selection mode will select facets instead of triangles.

Set raycast polygon selection mode will select both front and back faces of an object.

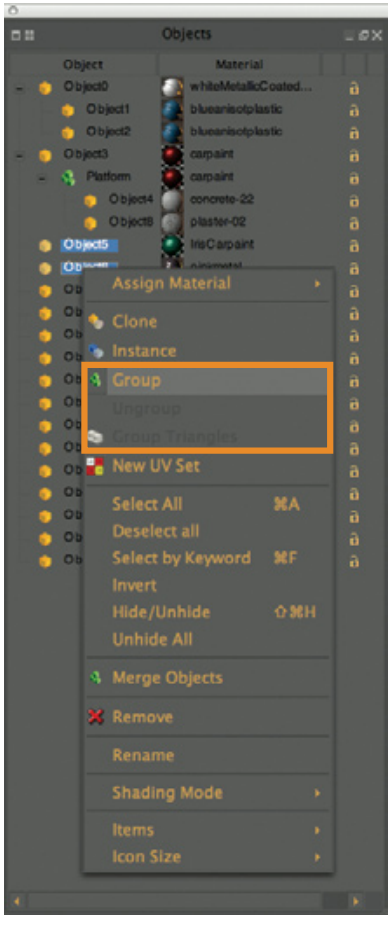
Set front-face polygon selection mode will select only front facing triangles.

Set paint polygon selection mode allows you to drag the mouse to paint the selection over the surface. Use the **SHIFT** key to select more triangles while dragging the mouse.

SELECTION MENU



You can expand your selection by navigating through the drop down menus or by using the keyboard short cuts.



More options for working with groups are available via the Rightclick menu.

WORKING WITH GROUPS / HIERARCHIES

Objects can be grouped by selecting the objects to be grouped and choosing "Group" from the Rightclick menu in the viewports, or the Object list panel. Objects can be moved from one group to another, or removed from groups by dragging them out of the group in the Object list panel.

Objects can also be parented to other objects by drag and drop, and groups can also be parented to other objects. In this way you can easily organize your scene. The hierarchy depth is unlimited.

More options for working with groups and hierarchies are available via the Rightclick menu in the Object list panel. Please note that depending on the type of selected item, some of these options won't be available.

Group: Select more than one object and select this option to group the objects.

Ungroup: Select one or more groups and select this option to remove the objects from the group. The objects will be placed outside the group, they won't be deleted from the scene.

Expand All: Expands all the groups in the object list.

Expand Selected: Select one or more groups and select this option to expand the group(s).

Collapse All: Collapses all the groups in the object list.

Collapse Selected: Select one or more groups and select this option to collapse the group(s).

Groups can also be moved and rotated using a single pivot point. Select the group and press the Move / Rotate / Scale. A single set of transform handles will appear.

WORKING WITH INSTANCES

Instances can be selected and manipulated in the viewport just like regular objects. Using object selection mode, select first the object that has instances attached to it. Then click the instance selection mode button and select the instance(s) in the viewport to manipulate them. By default an instance inherits the material of its parent object but you can apply another material to instances by drag and dropping a material from the material list to the instances in the Instances Panel.

MERGE OBJECTS

Select two or more objects, Rightclick in the Object List Panel and choose "Merge Objects". The separate objects will be merged into a single object. This is useful to simplify your scenes (merge for example all objects that share one material), or to merge emitters to reduce the number Multi Light sliders in MXCL.

MAXWELL STUDIO (MXST):

TEXTURING & ASSIGNING MATERIALS

MAPS AND TEXTURES

Maxwell Studio provides built-in features to map textures to objects using different UV sets. Maxwell Studio also reads the UV mapping information exported from the 3D applications by the Maxwell plug-ins.

In order to texture an object, we need to introduce the concept of an UV set first. A UV set is an object property that tells how to map a 2D Bitmap onto the 3D object surface. There are different kinds of UV sets: cubic, spherical, cylindrical and planar to project the Bitmap according to the desired effect.

CREATING A NEW UV SET

Select the object and Rightclick in the viewport, or click the Geometry menu and choose "New UV Set".

The new UV set will be added to the UV Sets section in the Object parameters panel (where all UV sets belonging to the object are listed).

Every UV set contains a set of editable parameters. These parameters are available in the Object Parameters Panel – UV parameters section. You can add as many UV sets as you want to a single object. Every UV set will be given a unique "channel" number.

For details about the parameters in the UV set parameters panel, please see page 74.

UV SET – CHANNEL ID

It is important to understand that the channel ID of the UV set is the way for Maxwell Studio to know which texture should use which UV set. You specify this channel number in the material editors texture picker.

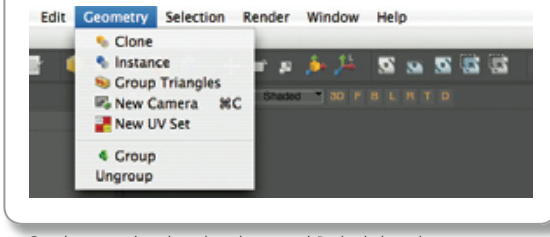
For example, if you have two UV sets applied to an object, one cylindrical with the channel ID of 0, and one flat UV set with the channel ID of 1, and you want to map a texture to the object using the flat UV set, then you must specify in the texture picker for it to use Channel: 1.

MAPS AND TEXTURES



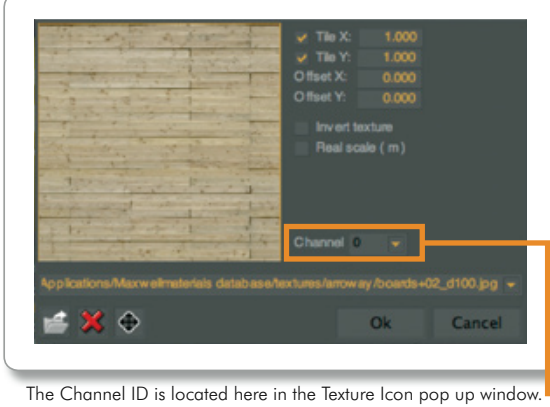
Cubic, Spherical and Planar UV sets.

CREATING A NEW UV SET



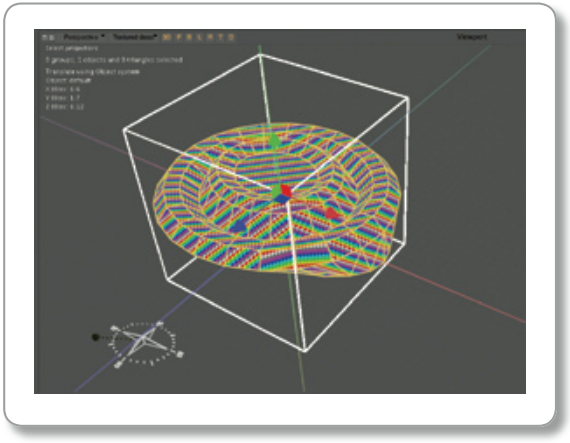
Or alternatively select the object and Rightclick in the viewport.

CHANNEL ID



The Channel ID is located here in the Texture Icon pop up window.

CUBIC UV



An object with a cubic UV set applied (white square).

ADJUSTING A UV SET

The UV sets can be moved/scaled/rotated in the viewports, the same as with objects, or you can use the numeric inputs in the UV parameters section of the Object Parameters panel.

You must select the UV set first, from the UV Sets section of the Object Parameters Panel. To see the projector in the viewport, switch to UV set selection mode.

This selection mode allows you to move/rotate/scale only UV sets and not the object itself.

CREATING A NEW MATERIAL

Rightclick in the Material List panel and choose "New Material".

IMPORTING A MATERIAL

Rightclick in the Material List panel and choose "Import". Browse to a folder containing an MXM file. When importing a material with textures, Studio will look for the textures in the following order:

The paths contained in the material itself.
The folder where the MXM is located.
The folder of the currently opened scene.
The five texture paths set in the Studio preferences (Edit > Preferences > Materials > Textures).

If Studio still can't find the textures it asks the user to locate them.

ASSIGNING A MATERIAL TO A SINGLE OBJECT

Three possible ways:

1. Select the material in the Material List panel and drag it over the object in the Object List Panel.
2. Rightclick the object in the Object List Panel, and choose Apply Material > Your material.
3. Select the material in the Material List Panel and drag it over the object in the viewport. If one or more objects were already selected the material is applied to the selection. If no objects were selected a red bounding box appears on the object that will receive the material.

ASSIGNING MATERIAL TO SEVERAL OBJECTS

Select one or more objects in the viewport or the Object list panel. Select the material in the Material list panel and drag it over the selection in the Object list panel or in the viewport.

ASSIGNING MATERIALS TO GROUPS / HIERARCHIES

Select the material in the Material list panel and drag it over the group in the Object list panel. If the objects in the group/hierarchy didn't already have a material assigned, the material will be assigned to all the objects. If the objects had a previous material, the new material will be applied only to the parent/group object. To change the material assignment for all the objects in this case, hold down the Ctrl key and drag drop the material over the parent/group. Holding the Ctrl will update the material for all the children as well as the parent.

ASSIGNING MATERIALS TO TRIANGLES

Enter triangle selection mode and select some faces. Select the material in the Material list panel and drag it over the faces selected in the viewport. Alternatively you can drag and drop a material over an existing triangle group in the Triangle Groups section of the Object parameters panel. The material will appear next to the triangle group.

ASSIGNING MATERIALS TO INSTANCES

By default, an instance inherits the material from it's parent object but you can apply another material to an instance by drag and dropping a material from the material list to the instance in the Instance Panel. The object containing the instances must first be selected for the instances to appear in the Instance Panel.

RENAMING A MATERIAL

The material name can be changed by pressing **"F2"** with the material selected in the Material list panel.

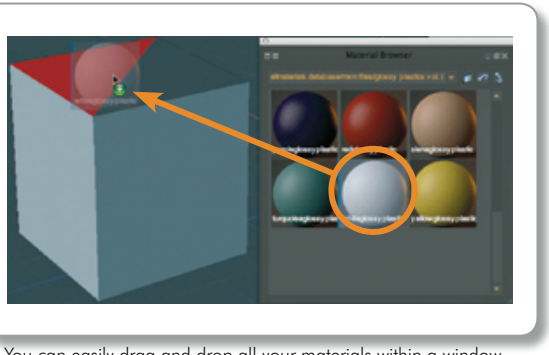
ENABLING / DISABLING TEXTURES

Textures can be enabled or disabled using the check box to the left of the texture icon.
Please see the Material Editor Panel section on page 29 for more options.

ADDITIONAL TEXTURE OPTIONS

Options for tiling and offsetting the texture are found in the texture picker. For details on these options, please see the Material Editor panel section on page 28.

ASSIGNING MATERIALS TO TRIANGLES



You can easily drag and drop all your materials within a window.



MAXWELL STUDIO (MXST): RENDERING

VIEWPORT RENDERING

Rendering can be done directly in the 2D/3D using the following buttons on the right:

Depending on whether a camera or perspective mode is active, the render will cover only the camera frustum or the full window. Also, the render can be launched from an orthographic view.
To cancel the render process, click anywhere in the viewport.

BLOW UP REGION

This rendering command allows you to draw a render region in the viewport, and render that region at the full resolution set in the camera settings. The ratio of the render region will be kept. For example if you draw a render region 200x400 pixels (a ratio of 0.5), and the camera resolution set to 500x500, the rendered blow up region will be 250x500 pixels.

SENDING THE SCENE TO MXCL RENDER / VIEWER

Press the render icon in the top row of icons. This will send the .MXS to the MXCL Viewer and start the render. More info on the MXCL Viewer options can be found on page 102.

Render options for both viewport rendering and rendering via MXCL are found in the Render Options Panel. A detailed explanation of each option is found on page 82.

Shortcuts:

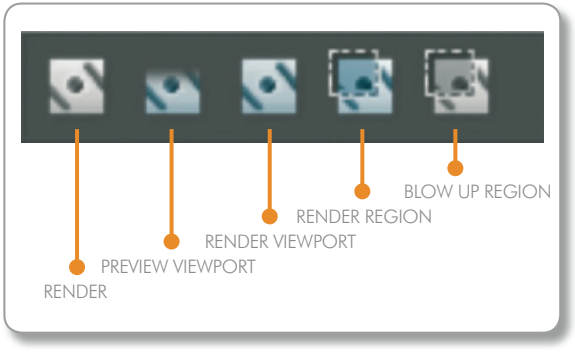
CTRL + P = Preview

CTRL + SHIFT + P = Render

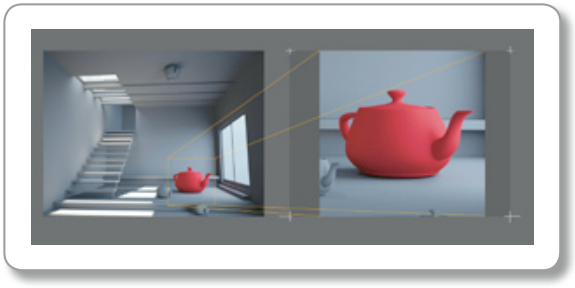
Preview Vs Render

Both commands “render” the scene, but the preview render uses the Maxwell preview render engine called RS0, while the Render command uses the main render engine called RS1. Preview rendering will be faster but of worse quality. It can be useful however for checking light levels and if textures are mapped correctly to objects.

VIEWPORT RENDERING



BLOW UP REGION





PACK AND GO... FUNCTION

This function can be accessed from File > Pack and Go. The Pack and Go function lets you copy all materials/textures/IOR files used in the scene, as well as the scene file itself, to a folder of your choice. This makes it very easy to share scenes with other users, or use the Pack and Go function if you want to quickly organize your scene, making sure you have gathered everything that is needed.

MAXWELL STUDIO (MXST): PREFERENCES

The Preferences can be accessed from the top menu, Edit > Preferences.

GENERAL

Delete temporary files when closing: When exiting Studio, this option will delete the temporary .MXS files created for rendering.

APPEARANCE

Load Studio look: This option will display the Studio default grey look.

Show RGB colours in axis: In object and camera panels, the X, Y, Z axis numeric input boxes can display a colour, indicating the axis of the numeric input (X=Red, Y=Green, Z=Blue).

Scroll in lists to the item selected in viewport: The object list panel will automatically scroll to show the currently selected object.

Check for updates automatically: By selecting this checkbox Maxwell will check for any new Maxwell Render™ updates available.

Icons size: Set the default icon size for objects, materials and the toolbar.

WARNINGS

You can specify here whether Studio should show warning pop-ups before proceeding with operations such as deleting objects and materials. "Do not show material performance warnings" check box is used for hiding pop-ups when you turn on dispersion or load an .IOR file in the material editor.

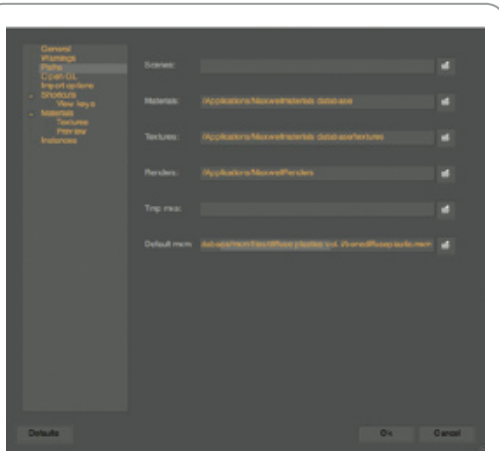
PATHS

You can specify here the default paths that Maxwell should use. Paths can be set for: Scenes, Materials, Textures, Renders, Temp .MXS files (used when rendering through MXCL viewer), Default MXM.

PREFERENCES PANEL – GENERAL



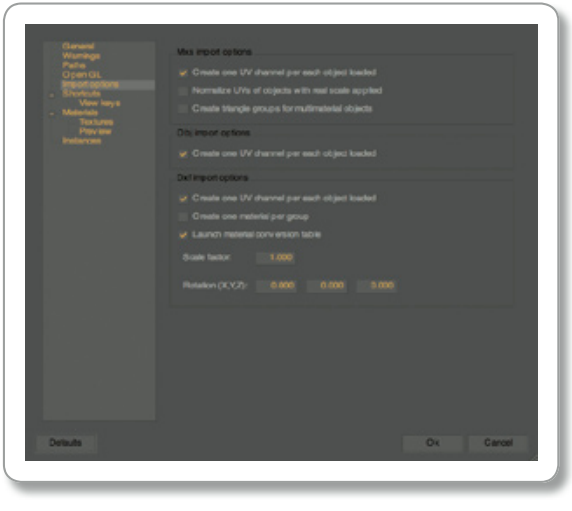
PREFERENCES PANEL – PATHS



PREFERENCES PANEL – OPENGL®



PREFERENCES PANEL – IMPORT OPTIONS



OPENGL®

APPEARANCE

Set colour: Colour of viewport backgrounds.

Threshold: Maximum angle to merge polygon lines shown in the viewport (this is only applied to OpenGL® display, no polygon lines are merged for rendering).

Enable sky in new scenes: Physical sky will be on by default in new scenes.

DISPLAY SELECTION MODE

Wire: selected objects will have their wireframe lit up in orange.

Brackets: selected objects will display brackets surrounding them. This mode can be useful when adjusting textures on dense objects so the wireframe doesn't obscure the texture.

PERFORMANCE

Vertex Buffers: Uses the vertex buffer feature of OpenGL® 1.5 to greatly increase viewport speed with heavy geometry. Disable this feature if you experience problems or artifacts in the viewport display.

Smooth AA: Enable / disable line antialiasing.

Lights: Number of lights used in OpenGL® viewports.

Texture Res: Texture resolution to use in the OpenGL® viewports.

Show bounding box when navigating: Acceleration mode showing the objects as bounding boxes when rotating/panning/zooming in the viewport.

Use absolute grid: By default the Studio grid adapts to the current zoom level. Using absolute grid allows you to specify a fixed grid.

Spacing: Distance between each grid line.

Lines: nr of lines to display in the grid (ex. if Spacing is set to 1m, and Lines to 10, the entire grid will be 10m big).

Major lines frequency: How often a thick grid line should appear (ex. if set to 2 every other grid line will appear thicker).

IMPORT OPTIONS

MXS IMPORT OPTIONS:

Create one UV set per each object loaded: If an object in an .MXS file (generated by a plug-in for example) does not have any UV information, this option will create a UV set for the object.

Normalize UVs of objects with real scale applied: If some objects in the MXS file are assigned materials which have real scale enabled, this option will normalize the UVs of those objects so that the textures will be displayed and rendered properly for those objects.

Create triangle groups automatically in multimaterial objects: This option is useful for importing older MXS scenes, in which case Studio will create the triangle groups for each imported object that had multiple materials applied to it. If this option is off, Studio still imports the objects correctly, with multiple materials applied, but you will not have any triangle groups to edit in case you want to add/delete to the triangle selection or apply other materials to the triangle groups. Please not that for a scene with many objects, turning this option on will increase scene loading time. The newer plug-ins automatically create triangle groups so this option is not necessary.

OBJ IMPORT OPTIONS:

Create one UV set per each object loaded: If an object in an .OBJ file does not have any UV information, this option will create a UV set for the object.

DXF IMPORT OPTIONS:

Create one UV channel per each object loaded: If an object in an .DXF file does not have any UV information, this option will create a UV set for the object.

Create one material per group: DXF layers will be imported as groups in Studio and this option creates and assigns the same material to all objects that are part of that group.

Launch material conversion table: When importing a DXF with several layers, this option brings up the material conversion table which lets you specify which material should be assigned to which layer.

Scale factor: Lets you specify the scale that was used for creating the DXF file. If your DXF was created using meters, leave this option at 1.000. If created in centimeter(cm), set it to 0.1. If it was created using millimeter(mm), set this option at 0.01.

Rotation (X, Y, Z): Lets you change the rotation of the DXF file for systems that use the Z axis as the up axis for example.

SHORTCUTS

Allows you to set your own shortcut keys for Studio commands.

View keys: You can see in this menu all the keyboard shotcuts listed.

Invert rotation: Allows you to invert the rotation behavior when rotating the view in the graphical viewports.

PREFERENCES PANEL – IMPORT OPTIONS



PREFERENCES PANEL – MATERIALS







MATERIALS

Set texture paths and material editor preview options.

TEXTURES:

Extension independent textures: This feature is very useful if you wish to convert a series of materials that use textures in one format, to materials that use the same textures, but in another format.

For example, if you have 100 materials using only .tga textures and you have converted those textures to .jpg to save space (and kept the same texture names), drag and drop all your materials from the Material browser into the Material list panel in Studio (you can select all of them and drag and drop all materials at once). Studio then sees that the .tga versions of the textures are no longer available and instead searches the same textures by name, but with a different extension. This way all your materials have been instantly converted to use the .jpg version of your textures. If you wish you can now select all your materials from the Material list panel, and drag and drop them back into the Material Browser for later use.

IOR files: Set the location of the IOR material files.

PREVIEW:

Quality Factor (1–10): This defines the quality of the preview render, higher is better.

Bounces: Number of times light rays should be allowed to bounce. If your preview scene contains complex objects, or several in front of another and you want to preview a transparent material, raise this setting if you get black parts in the preview.

Scale Reduction: Specify the scale reduction of the preview thumbnail. This will help speed up material preview renders.

Use RS1 engine for the material preview: Normally, the preview renders use the RS0 render engine, which is the preview render engine. Checking this option will instead use the final rendering engine, RS1, for making the material preview renders. It is useful if you want more accurate material preview renders. Render time of the preview will be increased using this option.

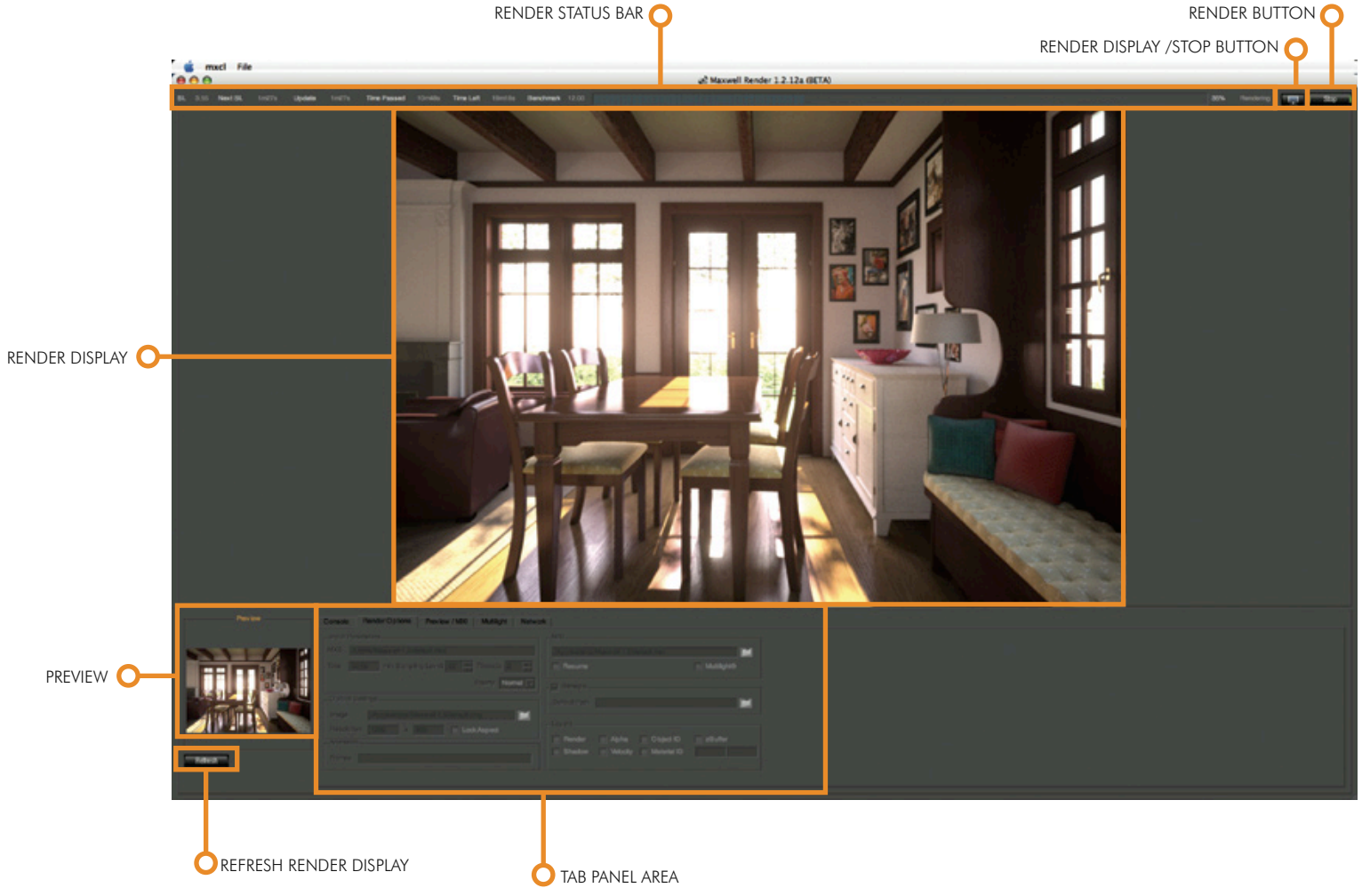
INSTANCES

Display Instances: Enables / disables the displaying of instances.

Max Instances Displ: Useful for limiting the maximum of instances displayed.

Shading: Default shading for instances.




RENDER STATUS BAR
RENDER BUTTON
RENDER DISPLAY /STOP BUTTON
RENDER DISPLAY
PREVIEW
REFRESH RENDER DISPLAY
TAB PANEL AREA

MAXWELL RENDER

VIEWER (MXCL)

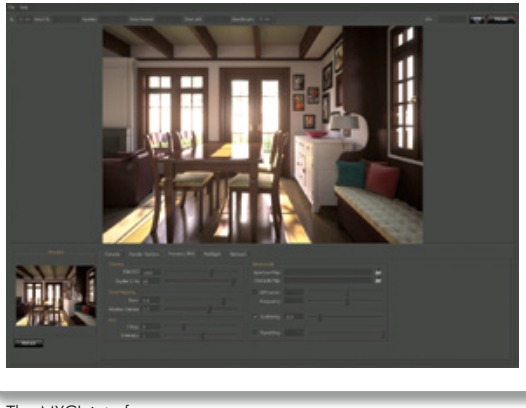
MXCL provides a standalone interface that allows users to load .MXS scenes to render, view the rendering progress and adjust render parameters. Many of the parameters can be adjusted while MXCL is rendering. While adjusting parameters, the small preview image is updated in realtime.

MXCL also allows users to load .MXI files, the Maxwell native file format. An MXI file is always created when rendering with Maxwell. It contains high dynamic range image data and other Maxwell Render™ data.

This interface is opened automatically when the render button is pressed in Studio. To display it also when rendering from the command line, the option –display or -d is used.

The Maxwell Viewer provides a visualisation of the render in progress, controls to tune the image while the render is in progress, including tone mapping, interactive Multilight™ control, interactive f-Stop and shutters peed and more.

MAXWELL RENDER VIEWER (MXCL)



The MXCL interface.

FILE MENU

Open MXS

Open an MXS file for rendering. Press the Render icon to start the render.

Open MXI

Open an MXI file for viewing and modifying.

Save MXI

Save an MXI file.

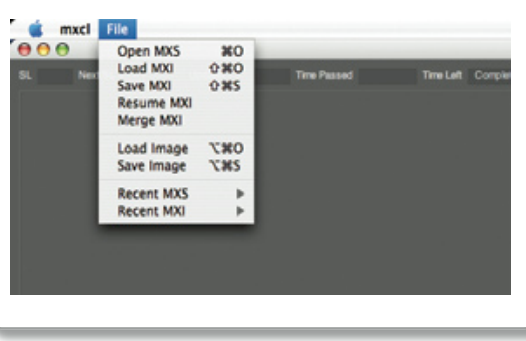
Resume MXI

Lets you load a previously rendered MXI to resume rendering. Please note that the MXS scene must be in the same location as for the previous render. Alternatively, you can use the Open MXS command to load the MXS instead, and check “Resume” in the Render Options tab to resume rendering.

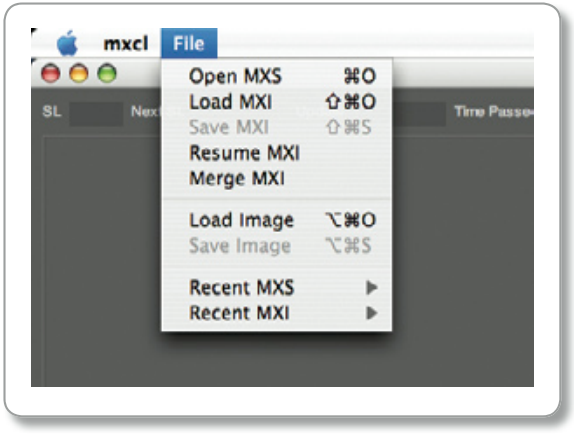
Merge MXI

Lets you manually merge a group of MXI files generated in cooperative render mode. Select several MXI files at once in the file browser, click open, then MXCL will ask you where to save a merged MXI.

FILE MENU



FILE MENU



Load Image

Load a bitmap file. You can load both LDR (.jpg, .tif etc) and HDR/EXR files. You can adjust their brightness using the intensity slider in MXCL and then save them as an MXI/HDR/EXR image to use for Image Based environment lighting or for Image Emission in the emitter settings.

Save Image:

Save a bitmap of the render view. You must specify a file suffix when saving, for example "myimage.tga", to save the render as a .tga format. Currently supported output formats are: .bmp, .tga, .jpg, .png, .tif, and .hdr.

Recent MXS

Shows a list of the most recently opened MXS files for quick loading.

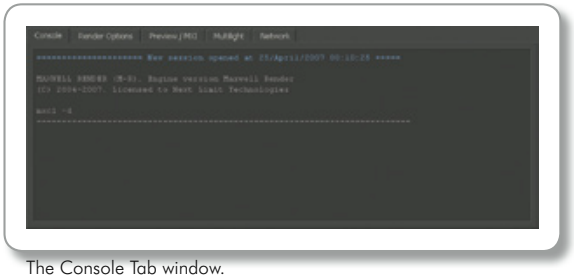
Recent MXI

Shows a list of the most recently opened MXI files for quick loading.

Exit

Exit MXCL viewer.

CONSOLE TAB



The Console Tab window.

 Display/Hide the current render in MXCL.



Start/Stop/Resume the current render.

RENDER STATUS BAR

SL	=	Current sampling level.
Next SL	=	Time to next sampling level.
Update	=	Time to next image update between samples.
Time passed	=	Total time elapsed.
Time left	=	Time left to finish.
Benchmark	=	Maxwell benchmark number (higher means faster rendering). The benchmark number is scene dependant.

Image Update Interval

MXCL updates the main image at every new SL reached when the render has just been started. If the next SL level takes more than 10 minutes to complete, MXCL continues to updated the image every 10 minutes instead of the next SL, showing the incremental SL reached.

CONSOLE TAB

This panel provides information about the rendering process, scene statistics, etc. Any error or warning messages are also displayed in the Console tab. If your scene does not start to render, look first in this panel for information on what might be the problem.

RENDER OPTIONS TAB

This panel shows the rendering options that can be adjusted in MXCL. Most of these options can be set from the command line and have already been explained (see the Render Options in MXST section on page 82), however we will go over each option here as well, in particular the MXI/Resume options which are specific to MXCL.

INPUT PARAMETERS:

MXS: Path and scene to render.

Time: Set the maximum render time (in minutes) for the render.

Sampling Level: Maximum sampling level required. This value controls the quality of the render. As with the “render time” parameter, the higher the sampling level reached, the more accurate the image obtained.

Threads: Shows the number of CPUs available to render.

Priority: Set Normal or Low priority for the render. Use Low priority when you want to work at your computer while rendering. With Normal priority, your computer may become less responsive when performing other tasks. The difference in render time between using Normal or Low priority is very small. For this reason it is recommended to use Low priority when rendering, in case you want to come back to the computer at a later time to work in other tasks.

Camera: Let you choose the camera to render from among the cameras existing in the scene.

Id Cpu:
This parameter is initialized to a random value each time an mxs is opened. It is useful for rendering the same mxs file on different computers that are not networked together. The resulting mxi files of each render can then be manually copied to the same computer and merged in MXCL using File>Merge MXI. The mxi files need a random seed value for the merging to work properly.

OUTPUT SETTINGS:

Image: Path and file type of final image.

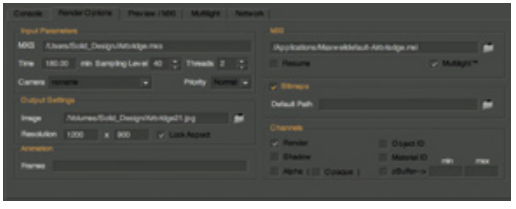
Resolution: Size of the final image.

Lock Aspect Ratio: To maintain the proportions of the image.

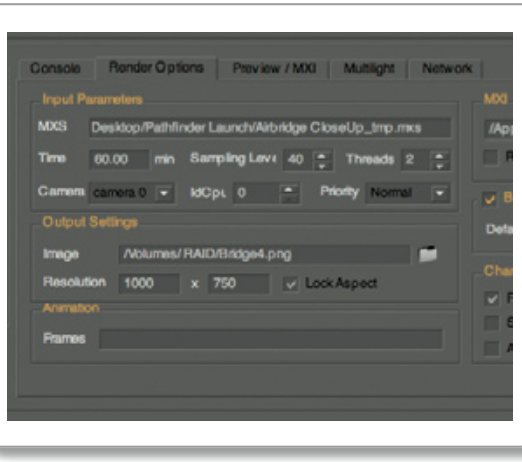
ANIMATION:

The user specifies a range of MXS frames to be rendered. For example: 5,8,9 will render frames name0005.mxs, name0008.mxs and name0009.mxs. To render frames 1 through 10, write 1-10.

RENDER OPTIONS TAB

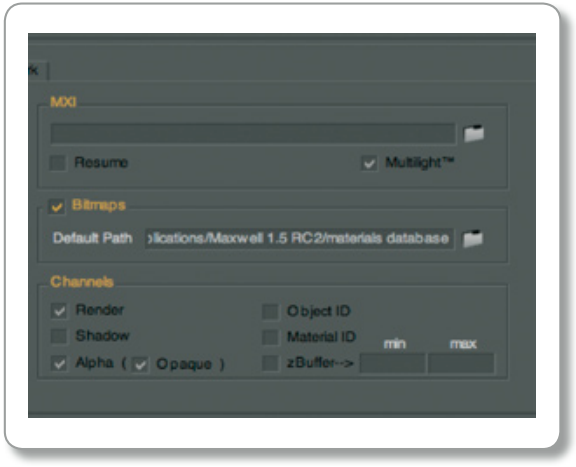


Render Options Tab.



Maxwell will finish the rendering process when one of these two conditions “Render time” or “Sampling level” are met. If you want to finish the render after a specific time, set a very high sampling level, and conversely, if you want to reach a specific sampling level, set a very high render time.

RENDER OPTIONS TAB



MXI:

Load/Save MXI: When loading a MXS scene in MXCL to be rendered for the first time, you can specify an output path for the MXI file. If you do not specify an MXI, a “default.mxi” file will be created in the Maxwell install directory.

If you are loading a mxs scene that has been rendered before, the MXI path for the previous render will appear in this path. You can either leave it as it is, or specify a new MXI to be created.

In case you are loading an MXS file that has previously been rendered on another computer and you wish to resume the render: the path to the MXI will no longer be correct, so you need to browse to the new location of the previously saved MXI, select it and choose Yes when MXCL asks if you wish to overwrite the MXI. Make sure to then check the Resume option.

Resume: Check this to resume a previously rendered scene, instead of starting a fresh render.

Multilight™: Stores a bigger .MXI for using the Multilight™ feature.

Note: When resuming a render, the original render must have Multilight™ already enabled, otherwise Multilight™ will not be available when resuming the render.

BITMAPS:

By checking this box you have control over the on or off function of the Bitmap. If you uncheck this option, the scene will be rendered without textures.

Default Path: The path where MXCL will look for textures and bitmaps.

CHANNELS:

Render: Output the main render image.

Alpha: Output an alpha image.

Note: Selecting opaque will render refractive objects as solid white in alpha channel.

Shadow: Shadow Pass shows the cast shadows of the materials with the “Matte Shadow” Flag enabled.

Object ID: Output multicoloured object silhouettes.

zBuffer: Output an image representing scene depth within the two values specified in Z buffer range. The range is in meters.

Material ID: Output multicoloured object silhouettes.

PREVIEW / MXI TAB

These controls can be altered in realtime while rendering (except for the SimuLens™ parameters), and also after a render is finished. The preview thumbnail to the left is updated in real-time when a “Tone Mapping” or “Camera” value is changed. Maxwell will update the main image using the last edited values when the main image is refreshed (Update time is reached).

CAMERA:

Film ISO: Sensitivity of the film to light (the higher the ISO number the higher the sensitivity).

Shutter (1/s): The shutter speed, specified in 1/n of a second.

TONE MAPPING:

Changes the dynamic range of the images.

Burn: Tone-mapping parameter that controls how fast the image is overexposed.

Monitor Gamma: Tone-mapping parameter that controls the monitor gamma of the output image.

MXI:

f-Stop: Controls the aperture of the lens.

Intensity: Intensity of the emission map.

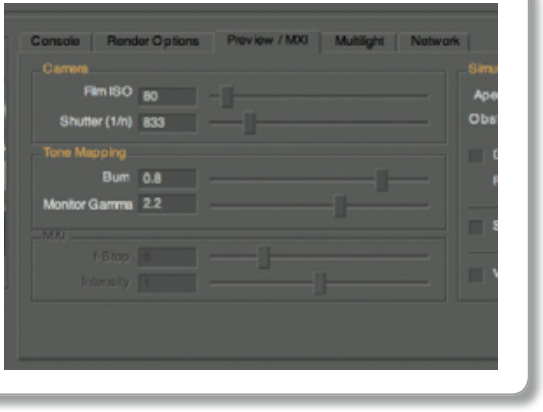
The MXI options are only available for adjusting MXI files, or LDR/HDR/EXR images for using as MXI/EXR fi les in emitters. Adjusting the f-Stop or intensity of the LDR/HDR/EXR images will change their intensity when used in emitters.

To convert an LDR image (jpg, tif, png etc) into an MXI or EXR to use in an image based emitter, load the image using File>Load Image. Adjust it’s intensity using the f-stop and/or the Intensity sliders, then save the image as either an MXI from File>Save MXI or an EXR from File>Save Image.

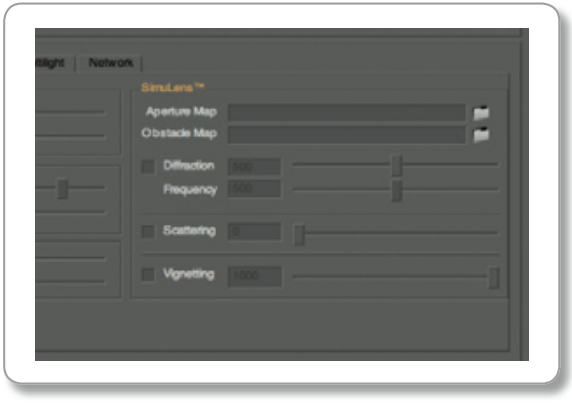
PREVIEW/MXI TAB



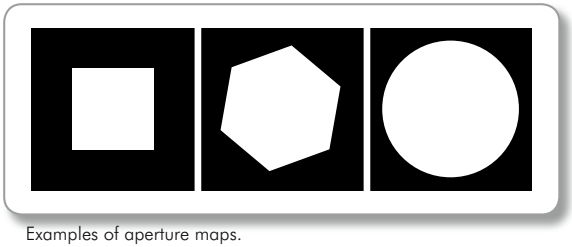
PREVIEW/MXI TAB



PREVIEW/MXI TAB

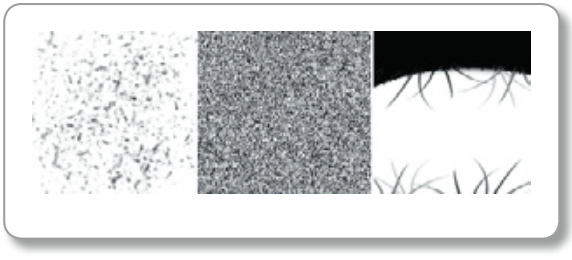


APERTURE MAPS



Examples of aperture maps.

OBSTACLE MAP EXAMPLE



SIMULENS™:

Allows you to control the lens diffraction, lens scattering, and vignetting effects of the Maxwell SimuLens™ system.

Diffraction Effects

Happens when light goes through small holes, causing interference patterns. It is a very important phenomenon in optics, as it explains why a perfect telescope (or microscope) cannot be built. Light will always cause slight interference patterns because of the optical components used, causing the visual “artifact” known as glare.

The diffraction effect can also be used on HDR images. Simply load it using the “File > Load image” option and apply diffraction to it.

Aperture Map: The shape of the diaphragm will model the pattern of light that reaches the film. For example, a circular diaphragm will create circular patterns; a hexagonal diaphragm will create 6 light streaks. You can set the diaphragm shape using a black/white map (it can be a colour one) called the aperture map. Note the examples on the left show a bigger white area for clarity, in practice the white area should be smaller in regards to the black area.

Obstacle Map: Water drops, eyelashes, dirt, etc on the camera lens will also cause diffraction effects. Again, a white/black map is needed. If you don’t want to use an obstacle map, you can leave this path blank, you only need an aperture map for diffraction to work. Anyway, if you want to use an obstacle map be aware that you also need to have an aperture map loaded.

Diffraction: Controls diffraction/glare intensity.

Frequency: Controls the frequency of colouring in diffraction effect. Higher values will make the patterns denser.

Scattering: Commonly known as bloom and happens when the light is scattered inside the lens before reaching the film.

Vignetting: Vignetting is an artifact darkening the image through the edges due to camera optics, now you can partially or completely remove it by dragging the slider from 1000 to 0.

The obstacle map and the aperture map, must both have the same resolution. The render resolution and the maps do not necessarily need to have the same resolution, but the more similar they are in resolution, the less diffraction distortion. The obstacle map should have the inverse colours of the glare map so for example if you have a white hexagonal aperture for the glare map and the rest is black, the obstacle map should be all white with some lines, small scratches etc in black.

MULTILIGHT™ TAB

Multilight™ is a very useful feature that allows you to interactively adjust the intensity of the emitters in the scene and to alter the ISO and shutter after rendering is finished. The adjustments can be keyframed and animated over time, and a sequence of images can be saved. This makes it a very powerful tool as it allows you to save different images of the same scene under different lighting conditions and even make lighting animations from only a single render.

The Multilight™ tab contains the Emixer, where you adjust intensity of the lights and can also animate the ISO and Shutterspeed. Each emitter in the scene will be represented by a slider with the name of the emitter, including the Sky (any of the available Sky options) and HDR/MXI environment.

The Emixer key framed sequence can also be saved as an .emixer file. This is useful if you have several camera views of the same scene and you want to apply the same lighting animation to other camera views.

Light Slider: Controls the intensity of the light. It has a text box for specifying the exact intensity.

S: Solo button, will set this light as the only visible light, muting all the others. An important thing to remember is that the Solo buttons work on the principal of an audio sequencer. For example if you have 20 lights in the scene, you can choose to Solo two lights. This is easier than having to mute 18 lights if you only wish to see the influence of two of the lights.

M: Stands for mute and will switch off the current light source.

Max Frames: Maximum number of frames in the Emixer timeline.

VIDEO:

Save sequence: Saves a sequence of images which can then be made into a video using a video editing application. Transitions are animated within MXCL.

Load Emixer data: Loads an emixer sequence file.

Save Emixer data: Saves an emixer sequence file.

MULTILIGHT TAB



Multilight Tab / Emixer.





Animated Timeline

Creating a Keyframe

Grab the slider to set a keyframe at the desired time. Rightclick on the slider, set the keyframe and adjust light values or turn them on and off.

Deleting a Keyframe

Go to the keyframe you want to delete, you will notice it is a keyframe because the slider will turn orange. Rightclick on the slider and choose Delete Keyframe.

Playback Controls

Go the beginning of the timeline.

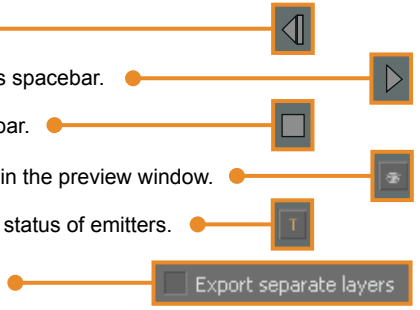
Play the sequence (preview) with this button or press spacebar.

Pause the animation with this button or press spacebar.

Disable preview: Use this button to disable changes in the preview window.

Toggle status of all emitters: Invert “solo” and “mute” status of emitters.

Export separate layers: By clicking this option you will get a separate image per emitter and per frame.



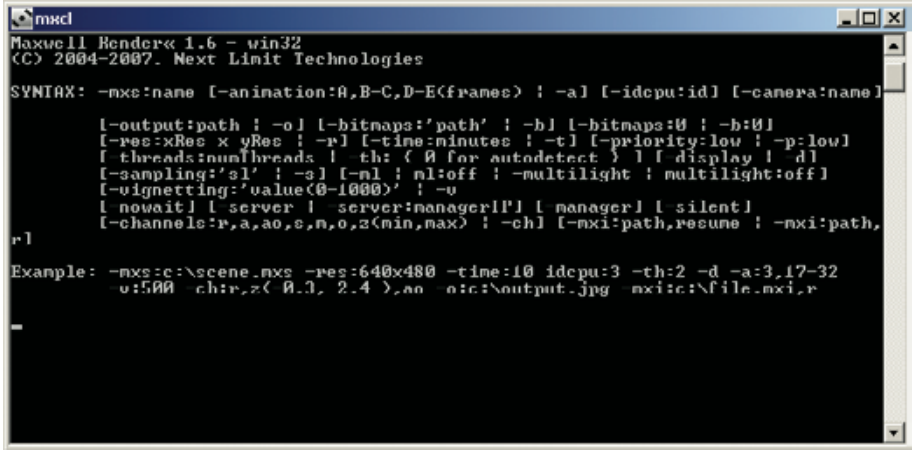
NETWORK TAB

Network tab gives access to users to the networking rendering controls in order to manage jobs sent to the render farm. Please refer to page 117 to know how network rendering and this particular tab work.

COMMAND LINE FLAGS

MXCL is the standalone rendering engine and can be used either from the command line, Maxwell Studio or from the 3D applications' Maxwell plug-ins.

In order to check that Maxwell Render™ has been properly installed, type "mxcl" in a command line window. MXCL Commands should be listed like in the image below (Windows OS):



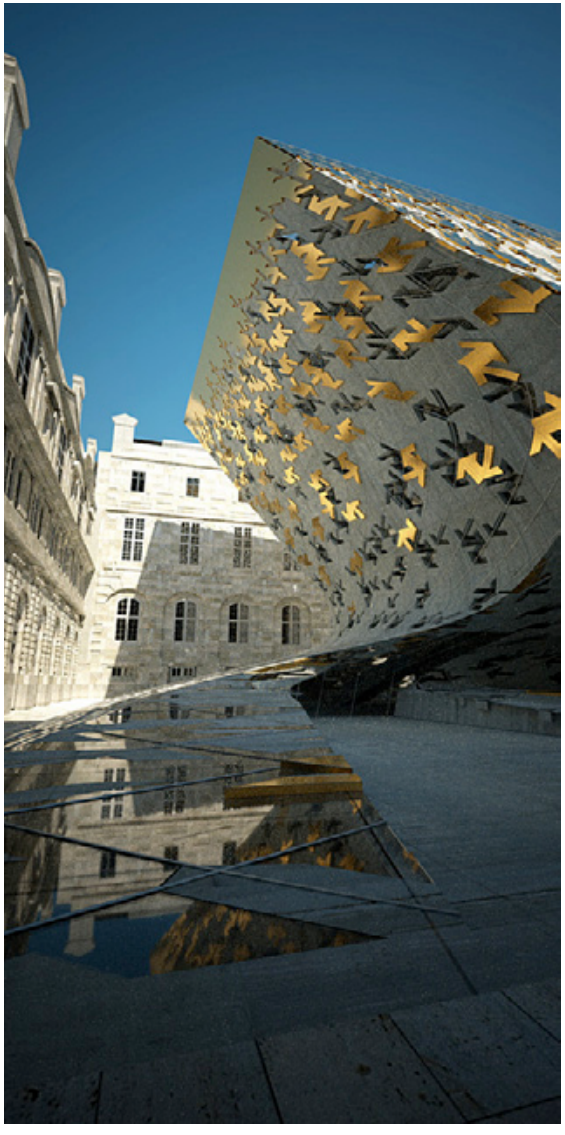


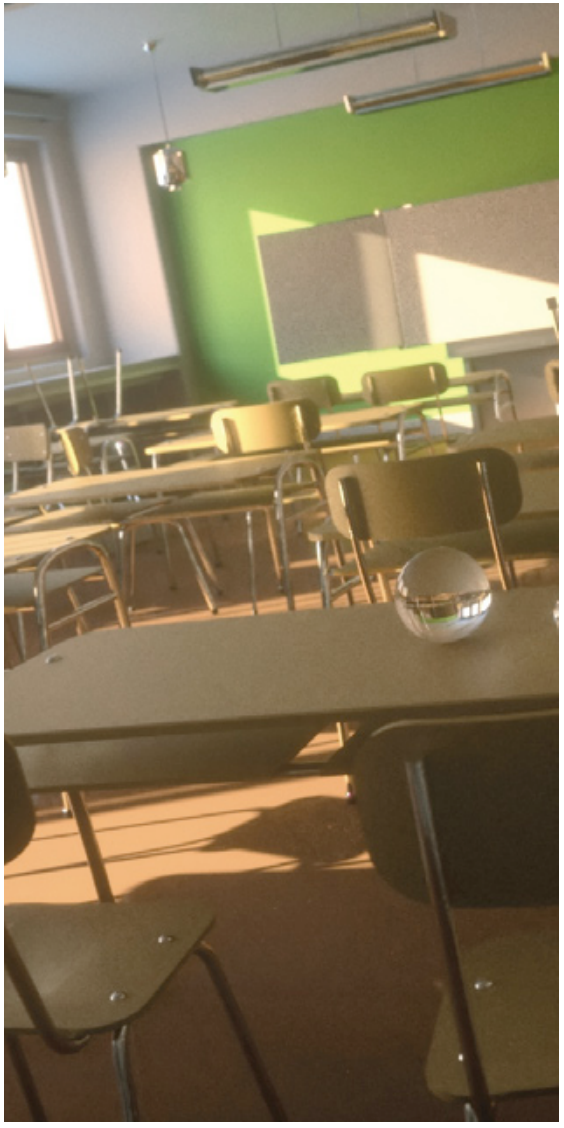


Following are the MXCL Command Line Options:

-mxs:name	Specifies the full path and name of the scene file to render (MXS).
-animation: A;B-C;D -a:A; B-C;D	Specifies a sequence of frames to render. This can be provided in the form of individual frames separated by a semicolon (3;5;7) or a range in the form A-B (from frame A to frame B) or a combination of both. **Example:** mxcl -mxs:scene.mxs –a:3;17-32
-idcpu:id	By default initialized to a random value when rendering starts. It is useful for rendering the same mxs file on different computers that are not networked together. The resulting mxi files of each render can then be manually copied to the same computer and merged in MXCL using File>Merge MXI. Each resulting MXI must have a different starting seed for the noise pattern to be slightly different in each MXI, otherwise the merging of MXI files will not work correctly. The user does not have to specify this parameter, unless they want to render with the same idcpu on all computers, in which case all the MXI files will have the exact same noise pattern (useful for testing purposes and comparisons).
-camera:name	Specify the camera name you want to render from in case it does not match with the active camera in your MXS scene file.
-output:filename -o:filename	Specifies the full path and name of the image file. By default, Maxwell always saves a file ‘default.tga’ in the output folder of the installation path. The file name can refer to any of the multiple graphic formats supported (tga, jpg, tif, png, etc). In case of sequences, the output files will be numbered with a four digit suffix. Example: mxcl -mxs:scene.mxs –o:c:\images\scene.jpg

-bitmaps:path -b:path	Set an alternative folder path for bitmaps location. If path is 0 (-bitmaps:0), Maxwell will discard all the bitmaps.
-res:WxH -r:WxH	Specifies the resolution of the render in pixels (W=width, H=height). Example: mxcl -mxs:scene.mxs –res:640x480
-time:M -t:M	Specifies the time (M = minutes) that Maxwell is allowed to use to render every frame. This is a very interesting feature. Maxwell can render the scene in a specified amount of minutes, providing the best possible quality. **Example: mxcl -mxs:scene.mxs –time:10**
-p:low -priority:low	Set Maxwell priority to low.
-threads:N -th:N	Specifies the number of threads (N) that Maxwell is allowed to use. Normally this should be equal to the number of CPUs available in the system. By default, N is the number of CPUs found in the system except in cases where hyperthreading features are available. **NOTE: When N is 0 (-th:0), Maxwell uses the maximum number of threads (processors) available.**
-display -d	Opens a window and displays the render in progress. This option is also used when distributing render tasks. For more information read the section related to network rendering.

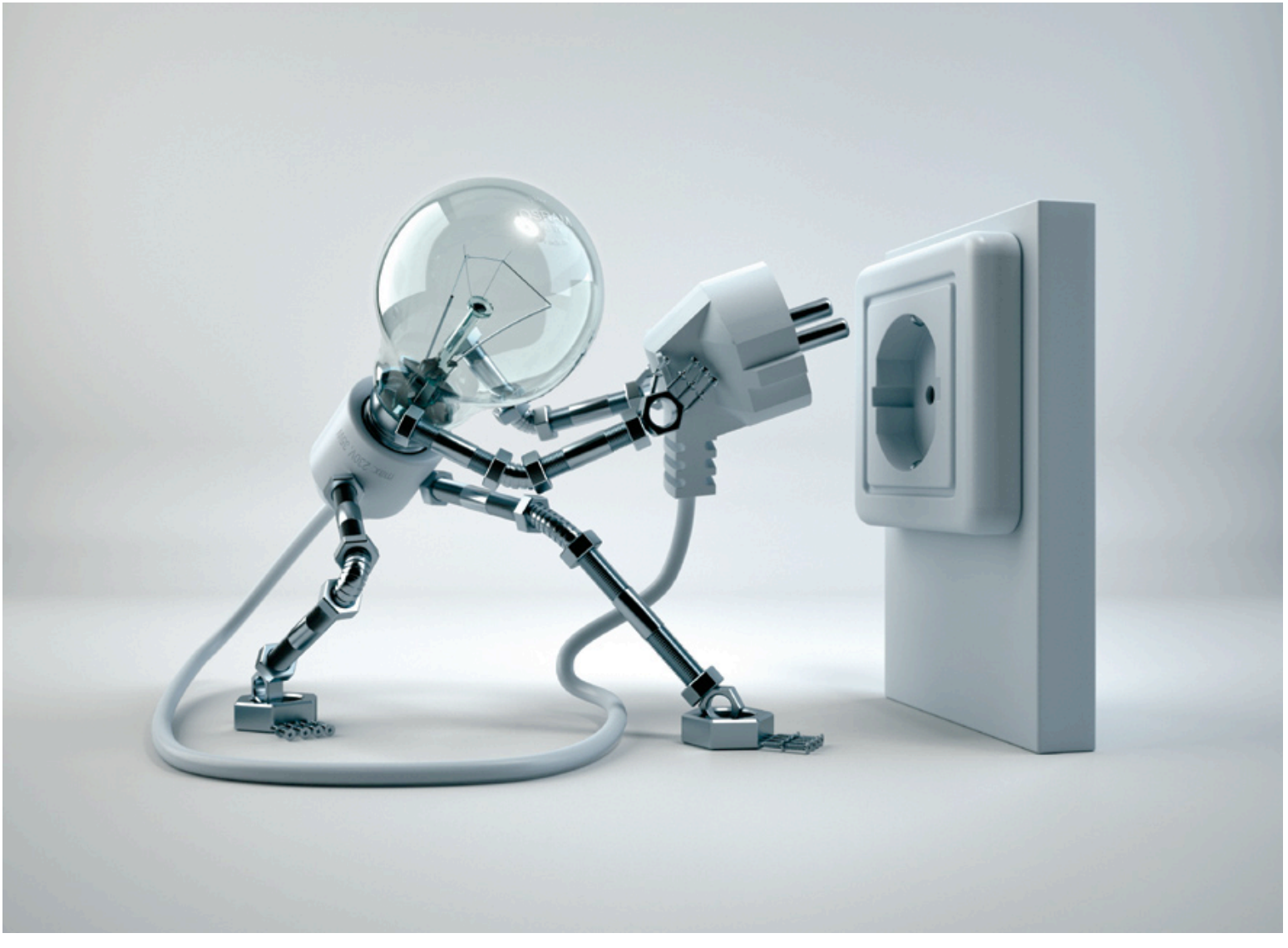




-sampling:level -s:level	This value establishes a quality level for the render. This value is useful when you want to render a sequence of frames using different hardware configurations. If the quality level is reached before the “maximum render time”, then the render ends. Alternatively, if the maximum render time is reached before the sampling level, the render also stops the calculus. To have an idea of the image quality during the render process, you can take a look at the command line window, where the sampling level is being actualized during the render process.
-ml	Enables Multilight™ function storing an mxi file with all the emitters’ information.
- vignetting:value<0-100> - v:value<0-100>	This option controls the vignetting parameter. 0 means no vignetting, 1000 maximum vignetting.
-nowait	Returns control to the console after the render finishes.
-server -server:ManagerIP	This option starts Maxwell in SERVER mode, allowing distributed render tasks. For more information read the section related to network rendering. -server:ManagerIP allows you to connect this server to a specific manager on your network, in case you are running several managers at once. If several managers are running and you start a server without specifying a particular manager IP, the server will connect to the first manager that sees it.
-manager	This option starts Maxwell in MANAGER mode, allowing distributed render tasks. For more information read the section related to network rendering.
- silent	Makes Maxwell Render™ in modes server or manager to start directly minimized on the icon tray, instead of opening the console window.

-channels: r,a,ao,s,m,o,z<min,max> -ch: r,a,ao,s,m,o,z<min,max>	This option establishes the different layers that Maxwell can export: r: Render channel a: Alpha channel ao: Opaque alpha. This option will render refractive objects as solid white in alpha channel. s: Shadow channel m: Material ID channel o: Object ID channel z: Z-Buffer channel. This option also requires two additional values indicating distances from the camera. The z value is then calculated by centering on the focal point (distance 0). **Note: That when the channel option is set, the r option should be added to obtain the rendered image (if required).**
-mxi:filename,resume -mxi:filename,r	When rendering, Maxwell writes a special MXI file that contains information about the rendering process. MXI is the high dynamic range Maxwell image format. this allows the user to resume previously rendered work. (Available in a next add-on) If this switch is not used, it will use the same name and path as the MXS scene. The resume option continues the render from a previously saved MXI file. In order to resume a previous render job and update the MXI file, ",r" option must be added. NOTE: The MXI file is useful to resume the rendering process later, to use Multilight™ (when Multilight™ option has also been enabled) or use it as a light emission map.
-rs:N	Specifies the render engine to be used. -rs:0 Preview Engine. -rs:1 Production Engine (by default).





NETWORK RENDERING

FIRST OF ALL, IT IS EASY!

UNDERSTANDING NETWORK RENDERING

In order to initialize network rendering, you need to know about the network components of Maxwell Render™.

NOTE: Hybrid Networking: Mac, PC and Linux can work together in the same network even for cooperative rendering.

THE NETWORK COMPONENTS ARE:

SERVER(S):

Responsible for rendering on every node. Each node can run one server at a time. Running MXCL.exe with —server turns a computer into a render node. So, you should start a server on every single computer you want to make a render with.

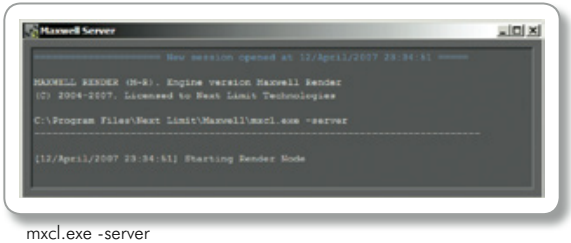
MANAGER(S):

Responsible for managing the render queue and distributing jobs among the network. Manager is the most comprehensive and sophisticated component of the Maxwell Network which works silently in the background. Running MXCL.exe with -manager switch on your computer is enough to initialize a manager in a renderfarm.

NOTE: A manager computer can also run as a server. In this way it can both manage the network rendering and also contribute to the rendering process.

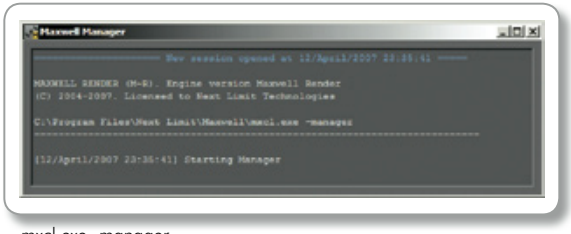
More than one manager can coexist in a network. These complex configurations are meant for big renderfarms. In a network with more than one manager each server will be “affiliated” to a manager.

USAGE – MAXWELL SERVER



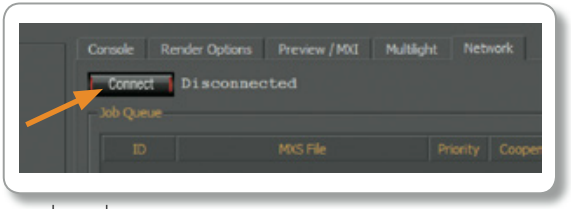
mxcl.exe -server
(optionally you can add -silent switch for starting minimized at task bar)

USAGE – MAXWELL MANAGER



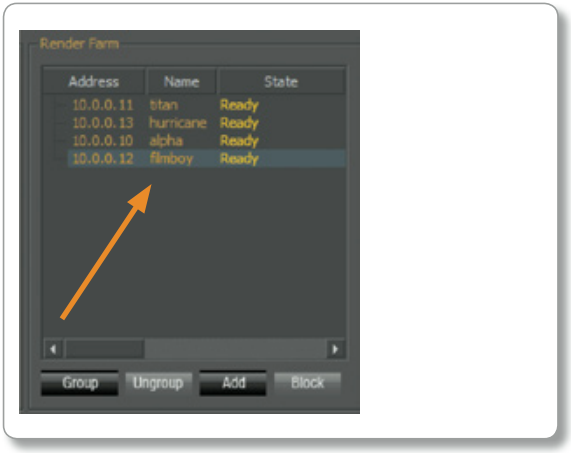
mxcl.exe -manager
(optionally you can add -silent switch for starting minimized at task bar)

USAGE



mxcl.exe -d

RENDER FARM



VIEWER:

Also called Maxwell Display, it's responsible for user interaction with Maxwell Render™ network. Viewer is the user-end frontface for managing every task in a network. Running MXCL.exe with -d switch on a computer is enough to bring up the viewer interface. Network settings can be found under the 'Network' tab in the viewer. Right after launching servers for every node and launching a single manager session on one of your nodes, you can start the viewer and hit the "Connect" button to start rendering on the network. Hitting the Connect button will automatically scan the network for a running manager and the servers. You can run viewer on as many computers as you wish, even at the same time but not on the same node in more than one session.

NOTE: That the Maxwell installer places a shortcut on your desktop with the -d flag already set. It is enough to double click this shortcut to start MXCL with the Viewer interface.

RENDER FARM:

Right after automatic detection of the manager on your network, the viewer will list the servers in the Render Farm window. If they are available and ready to render, their state will be "Ready" You can make server groups by selecting multiple servers from the list and hitting the "Group" button. Thus, you can send a job to a group of servers and another job to the others.

NOTE: If there is a server enabled but it is not available in the Render Farm window, revise your network connections.

JOB QUEUE:

Job Queue window will list the running/queued jobs you've sent to the renderfarm. You can "Add" more jobs, stop or remove them. It's the heart of network jobs management where you can monitor every single detail about the ongoing progress.



ADDING JOBS:

Hitting "Add" button will bring you the Add Job panel which allows you to define several parameters about the job to be added. First of all you need to select the scene to be rendered. Priority value lets you set a queue priority which helps you insert jobs prior to the ones which have already been sent to queue. The priority parameter can be set from 1 to 65536, 1 being the lowest priority. The Render Farm window will show you selected servers to be used for the job. You can still select The All Available checkbox and send the job to all available servers waiting to render. "Render Options" button will let you redifine the detailed scene parameters such as save options or resolution etc. Hitting "OK" will add the job to the queue and if the assigned servers are available, the manager will immediately distribute the information silently in the background and the rendering process will start. During distribution of jobs, you can monitor every single action per-node in realtime.

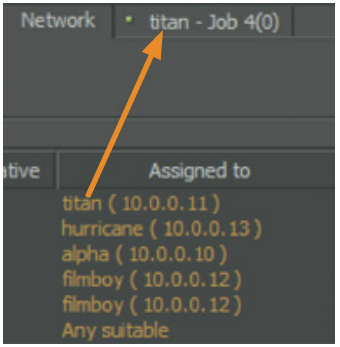
DISPLAYING JOBS:

One of the most powerful functions of the Job Queue window is the Display function. While servers are rendering you can select any of them and when you hit "Display" button it will automatically reveal the image being rendered on that node. Display button also supports instantaneous viewing of a cooperative job as merged during the render progress. To do this, select the job tree (instead of just one server) and hit Display. A green dot will help you identify a display tab which has recently had an update from the remote node.

To learn more about render options please see the chapter on MXCL at page 82.



DISPLAYING JOBS





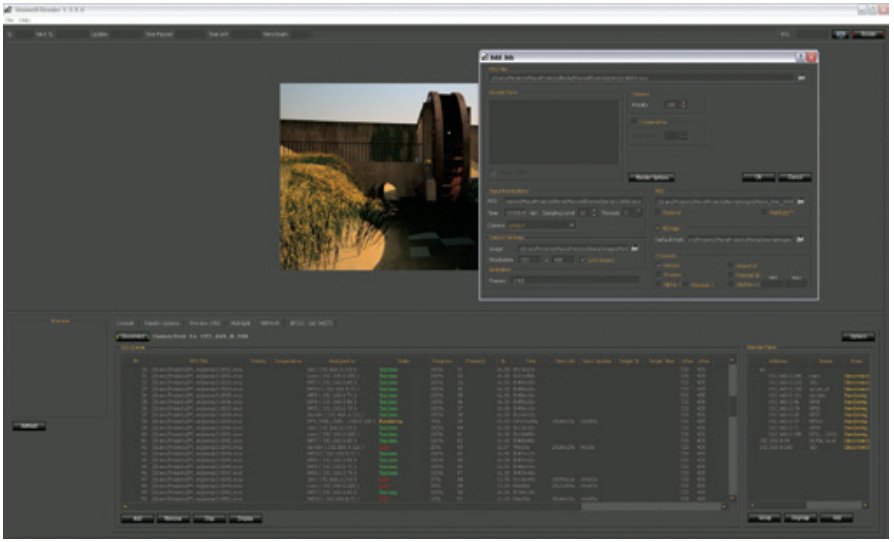
COOPERATIVE RENDER

MAKING A COOPERATIVE RENDER:

Cooperative mode is a special mode that allows selected servers to work on the same frame individually and to merge the images they've created at the end of the rendering process. Activating cooperative mode is as easy as selecting the "Cooperative" checkbox in the "Add Job" panel. Max Servers will let you limit the amount of Maxwell servers to be engaged for a single frame. While rendering, multiple nodes will render the same frame with a different entropy seed. When the job is finished, the manager will collect these results and merge them into a single output file. It is possible to preview cooperative jobs during the render by selecting the job tree and pressing the "Display" button.

NOTE: An output MXI must be specified as this will be the final merged file.

If the network fails or crashes at some point and the merging of MXI files is not completed, you could try to manually merge the cooperative .MXI files created during the render process. In this case, some of these cooperative .MXI files could give an idcpu warning; just ignore the message and continue merging the rest of the files. The file that gave an error should be ignored because it was merged before the crash, and therefore taken into the account. Locate each cooperative .MXI file in the temp directory of the operating system of each render node.





Note: It is strongly advised that there is only one Manager activated.

MAKING COOPERATIVE RENDERS MANUALLY:

In order to make a cooperative render manually, each MXI file from the different computers must have a different starting "seed" so that each render has a slightly different noise pattern. This random seed value is given automatically by the idcpu command, the user does not have to specify it (please check idcpu flag in command line flags for details on page 114).

Once the rendering has finished on each individual computer, you can use File > Merge MXI to select a folder where all these MXI files. MXCL will then merge all the MXI files and save a new MXI file which will have a higher sampling level than any of the individual MXI files (higher sampling level = less noise).

NOTE: In order to put all cooperative .MXI files together in a single folder, you will have to rename them and collect them from their respective computers. Locate each cooperative .MXI file in the temp directory of the operating system of each render node.

Select File > Load MXI and pick the merged MXI file that was just created. Once this file is loaded you can adjust it and make the appropiate adjustments in Camera, Tone Mapping, MXI and Simulens™. Once these adjustments are made you can save out an image file by selecting File > Save Image or an MXI file by File > Save MXI.



MAKE SURE:
You don't have firewall restrictions prior to initializing the Maxwell network.

AT FIRST:
Make simple and successful tests on your network prior to attempting final rendering.

ALWAYS USE:
Networked paths for everything possible, especially for output files.

RENDERING AN ANIMATION

Maxwell Render™ is capable of rendering animations. There is no problem of flickering in contours or textures. The only thing needed is a sequence of MXS files, that can be obtained via the specific plug-in you are using.

Once all the frames have been exported into individual MXS files from your host application, you have to add a job to the job queue (please refer to page 118) choosing any of the files of the MXS sequence. Make sure you display all Render Options and type the sequence of frames you want to render, otherwise you will only get the selected MXS rendered. Remember you can also render single frames from the same sequence by using a semi-colon ";" when typing.

Example: 1-10;12;20-23
This will render frames 1 through 10, frame 12, and finally frames 20 through 23.

OPTIONS



OPTIONS

This panel provides options for handling servers. For some reason (disconnection, power failures etc) servers may go offline and it may take some time before they become available again or they may stay offline forever. So, Server Timeout value lets you set max time in seconds to wait before discarding the unavailable server and proceed to the next. Since the chain of failures may last longer than expected, there is a "Try Next" variable to limit the number of forwarding actions. By default, it's three (3), which means that it will try to connect to three different servers, waiting 60 seconds each time to see if the server is available. If after three tries it still couldn't find a server, the render job will be stopped.

RENDER FARM BUTTONS



RENDER FARM BUTTONS

Group

You can select multiple servers by Shift or CTRL key combination and make a group from them. So later you can select multiple machines by selecting the group tree and send them jobs quickly.

Ungroup

Clicking Ungroup with a group tree selection will unchain all the servers in that group. If you do the same with selection of server(s) which are member of a group, it will only detach them from the group.

Add

Clicking "Add" will let you add a server manually by entering its IP address. That could be a server having a different range of IP than already autodetected.

NETWORK: COMMON SITUATIONS AND TIPS

Network and Distributed rendering won't work properly unless the MXS and MXM files are accessible to all render nodes. You must set up a shared folder in which to save these files that each node can see and read the data from. You will also need a shared folder that each node can write its data to.

NOTE: If you have more than ten render nodes all of these folders need to be set up on a machine that is running Windows Server because any other version of Windows will only allow ten simultaneous connections at any given time.

When doing animations make sure that you have plenty of hard drive space, each MXS file can easily be 100+ MB in size and will quickly fill up a small drive.

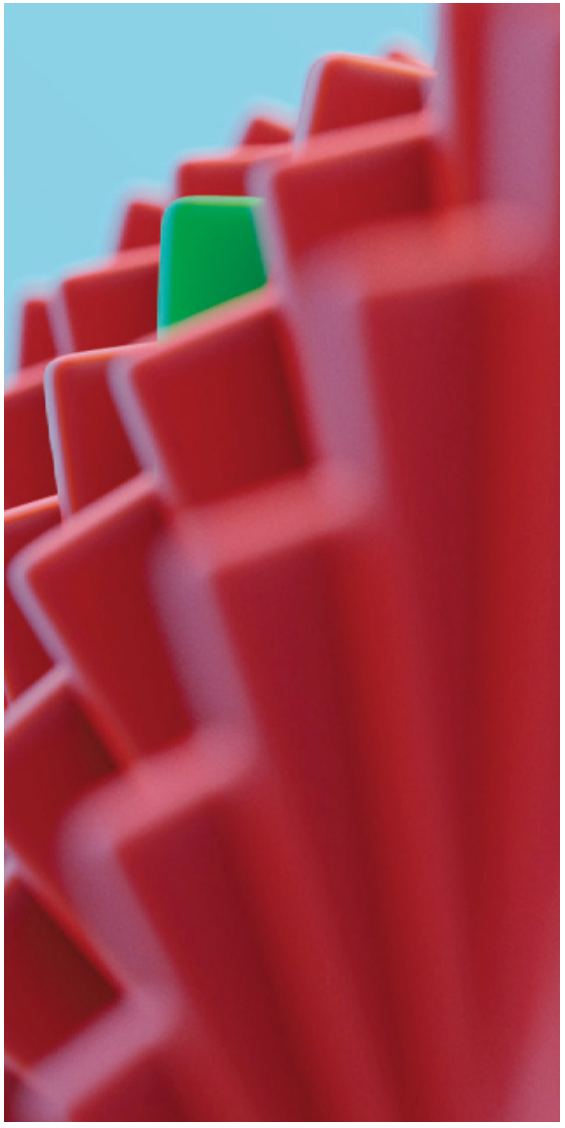
MXS saved with local texture paths

Both the MXS file and textures used in the MXS should be placed in a shared folder which all servers must have access to. The servers will look in the folder of the MXS for the textures. An easy way to accomplish this is using the Pack & Go feature of Maxwell Studio, which will copy your MXS and all the textures used in it to a folder of your choice.

Alternatively, you can keep your textures in a shared folder and when building your scene, you load the textures from this folder starting from Network in the File Browser, so that the texture paths are in UNC format. For example, your texture folder may be c:/mytextures, which you have shared. Your computer name is 'renderbox1' which is part of the Workgroup named 'farm'. Browse from My Network Places>Microsoft Windows Network>farm>renderbox1>my textures. The path for the texture will then be "\\renderbox\mytextures\texture.jpg" \\renderbox1\mytextures\texture.jpg (you can also type directly in the File name input of the File Browser: \\renderbox1 and your mytextures folder will appear in the list of shared folders). In this case it is not necessary to also move your textures to the same shared folder as the MXS.

Using a mapped network drive

In the case you are connecting to a folder as a mapped network drive, make sure you have added this folder as a mapped drive to all the servers, using the same drive letter.



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+ KEY 91

SHORTCUTS LIST

GENERAL

Open preferences	Ctrl+Shift+O
Exit Studio	Ctrl+Q
Undo	Ctrl+Z
Redo	Ctrl+Shift+Z

VIEWPORT NAVIGATION

Rotate	Alt+LMB
Pan	Alt+MMB
Zoom	Alt+RMB
Local rotate	Alt+Shift+LMB
Roll	Alt+Shift+MMB
Local Zoom	Alt+Shift+RMB
Slow rotate	Ctrl+Alt+LMB
Slow pan	Ctrl+Alt+MMB
Slow zoom	Ctrl+Alt+RMB

VIEWPORTS

Display/Hide viewport info	I
Display/Hide physical sky/HDR	K
Cycle viewport shading type	S
Display/Hide compass	Z

FILE

New Scene	Ctrl+N
Open scene	Ctrl+O
Import object	Shift+I
Save scene	Ctrl+S
Save scene as	Ctrl+Shift+S

SELECTION

Select object by keyword	Ctrl+F
Select all objects	Ctrl+A
Deselect all objects	Esc
Hide/Unhide selected objects	Ctrl+H
Cycle selection mode	T
(OBJECT, GROUPS, TRIANGLES, MATERIALS, UVSETS)	
Add to selection	Shift+LMB
Remove from selection	Ctrl+LMB

TRIANGLE SELECTION

Expand selection to connected region	/
Expand selection	+
Collapse selection	-
Invert selection	*
Expand selection to facet mode	F8
Raycast selection mode	F9
Front-face selection mode	F10
Paint selection mode	F11
(HOLD SHIFT TO ADD TO SELECTION)	

EDITING

Create clone	Ctrl+D
Create group	Ctrl+G
Move	W
Rotate	E
Scale	R
Selection handles (All)	Q
Delete	Del

CAMERAS

Create new camera	Ctrl+C
Display camera handles	L
(PRESS REPEATEDLY TO SWITCH FROM CAMERA HANDLES, CAMERA TARGET HANDLES, CAMERA+TARGET HANDLES)	
Autofocus	F

PANELS

Viewport	Ctrl+1
Material Editor	Ctrl+2
Material List	Ctrl+3
Material Browser	Ctrl+4
Object List	Ctrl+5
Object Parameters	Ctrl+6
Camera List	Ctrl+7
Camera Parameters	Ctrl+8
Environment Settings	Ctrl+9
Render Options	Ctrl+0
History Panel	Alt+Ctrl+1
Console Panel	Alt+Ctrl+2

RENDERING

Render to MXCL	Ctrl+R
Preview render viewport	Ctrl+P
Render viewport	Ctrl+Shift+P

RESOURCES

MAXWELL RENDER™

Next Limit's Maxwell Render™ official website, to keep you up to date with Maxwell Render™ news.
HTTP://WWW.MAXWELLRENDER.COM

Next Limit's official MXM Gallery website. An invaluable resource for Maxwell users – find more than 1,000 ready to use and FREE Maxwell materials in all sorts of categories. As a Maxwell user you too can contribute by uploading your own materials to the site.
HTTP://MXMGALLERY.MAXWELLRENDER.COM/

A completely new site for Maxwell Render™, a knowledge base featuring FAQ, tutorials and other useful info (scheduled for Summer '07).
HTTP://THINK.MAXWELLRENDER.COM/

Maxwell Render™ official forum, where Maxwell Render™ users share their knowledge, show their work and discuss about techniques, features and more.
HTTP://WWW.MAXWELLRENDER.COM/FORUM/

OTHER NEXT LIMIT'S PRODUCTS

Next Limit's official RealFlow4 website.
HTTP://WWW.REALFLOW.COM

Next Limit's official XFlow website.
HTTP://WWW.NEXTLIMIT.COM/XFLOW/

NEXT LIMIT TECHNOLOGIES

Next Limit's official website (developers of Maxwell Render™).
HTTP://WWW.NEXTLIMIT.COM

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